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MINI-FERTILIZER PLANT PROJECTS APPENDICES

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Preface

This document constitutes the appendices to the study "Mini Fertilizer Projects, Volume I" and contains apart from details regarding the sources of information, statistical material concerning the development of fertilizer consumption and special sections on the methodology of evaluation, the raw material potential in developing countries, as well as potential users of mini fertilizer plants.

CONTENTS

	<u>Page</u>
<u>APPENDIX</u>	
1/1 Sources of information for the study	6
2/1 Development of world fertilizer consumption 1975/76 - 1980/81	9
3/1 Methods used for economic evaluation in the study	12
3/2 Brief introduction to the use of of mathematical programming	117
4/1 Fertilizer consumption in developing countries in 1976/77 and 1981/82	134
4/2 Classification of developing countries according to their fertilizer consumption	174
4/3 Raw material potential in developing countries	176
4/4 Potential users of mini-fertilizer plants	201

Appendix 1/1 Information Sources

1. Reply to questionnaires from contractors and process owners	6
2. Reply to questionnaires from plant owners in developing countries	6
3. Direct contacts	7
3.1 Contractors and process owners	7
3.2 FAO information material received in Rome	7
4. UNIDO information material	7
5. Lahore seminar	8

	<u>Page</u>
6. Technical conference on ammonia fertilizer technology for promotion of economic cooperation among developing countries. Beijing.	8
7. Others	8
Appendix 2/1	
<u>Development of World Fertilizer Consumption</u>	
Table 1 World consumption of fertilizers, by regions 1975/76 - 1980/81	9
Table 2 World fertilizer consumption growth rates, by regions 1975/76 - 1980/81	10
Appendix 3/1	
<u>Methods used for economic evaluation in the study</u>	
Method of economic evaluation	12
Table 1-1.1-18 Total investment costs of N plants	32-49
Table 1-2.1-6 Total investment costs of P ₂ O ₅ plants	50-55
Table 2-1 Specific investment costs of N products	56
Table 2-2 Specific investment costs of P ₂ O ₅ products	57
Table 3-1.1 Total investment costs of ammonia-urea complexes	58
Table 3-1.2 Total investment costs of ammonia-nitric acid-ammonium-nitrate complexes	59
Table 3-2 Total investment costs of phosphate complexes	60
Table 4-1.1 Specific investment costs of N fertilizer complexes	61
Table 4-1.2 Specific investment costs per ton N in N fertilizer complexes	62

	<u>Page</u>
Table 4-2 Specific investment costs of phosphate complexes	63
Table 5-1.1-36 Production costs of N products	64-99
Table 5-2.1-9 Production costs of P ₂ O ₅ products	100-108
Table 6-1.1-2 Product values at factory gate of N products based on natural gas, per ton product and per ton N	109-110
Table 6-1.2 Product values at factory gate of N products based on fuel oil	111
Table 6-1.3 Product values at factory gate of N products based on coal	112
Table 6-2 Product values at factory gate of P ₂ O ₅ products	113
Table 7-1.1-2 Farm gate prices of N products, per ton product and per ton N	114-115
Table 7-2 Farm gate prices of P ₂ O ₅ products	116

Appendix 3/2

<u>A brief introduction to the use of mathematical programming in economic decision making</u>	117
--	-----

Appendix 4/1

<u>Fertilizer consumption in developing countries in 1976/77 and 1981/82</u>
--

Table 1/1-7 N consumption in developing countries by categories in 1976/77 and 1981/82	134-149
Table 2/1-6 P ₂ O ₅ consumption in developing countries by categories in 1976/77 and 1981/82	150-162
Table 3/1-6 K ₂ O consumption in developing countries by categories in 1976/77 and 1981/82	163-173

Appendix 4/2
Classification of developing countries
according to their fertilizer consumption

Table 1	Countries according to their annual consumption of fertilizers	174
Table 2	Countries according to their per hectare consumption of fertilizers	175

Appendix 4/3
Raw material potential in developing countries

Table 1	Production of natural gas and reserves in the developing countries	176
Table 2	Crude oil production, reserves and refining capacities in the developing countries	180
Table 3	Coal production and reserves in the developing countries	184
Table 4	Production of phosphate rock and reserves in the developing countries	187
Table 5	Production of potash and reserves in the developing countries	191
Table 6	Production of sulphur in-all-forms and reserves in the developing countries in 1981	193
Table 7	Raw material potential for fertilizer production in developing countries studied /1983/	197

Appendix 4/4

Potential users of mini-fertilizer plants

Table 1	Potential users of mini N fertilizer plants	201
Table 2	Potential users of mini P ₂ O ₅ fertilizer plants	204

Appendix 1/1 - Sources of information for the study

1. Reply to questionnaires from contractors and process owners:

Positive answers received from:

C.F. Braun and Co.
John Brown Engineers and Construction Ltd
Haldor Topsoe
Krupp-Koppers GmbH
Société Chimique de la Grand Paroisse
Sim-Chem Ltd
Snamprogetti S.p.A.
Uhde GmbH
Voest Alpine

Negative answers:

Five companies returned negative answers.

No answer:

Twenty-six companies did not reply.

2. Reply to questionnaires from plant owners in developing countries:

Answers:

Fertilizantes Nitrogenados do Nordeste St. Salvador
Azot Sanayii T.A.S. Turkey
Chemical Company of Malaysia Berhad. Malaysia
National Agricultural Chemicals and Fertilizer Ltd, Kenya

No answer:

Twenty-five companies did not return questionnaires.

Appendix 1/1

3. Direct contacts

3.1 Contractors and process owners:

Haldor Topsoe A/S, Copenhagen, Denmark
Humphreys and Glasgow Ltd, London, England
Imperial Chemical Industries (ICI), Billingham, England
Krupp-Koppers GmbH, Essen, Germany
KTI-Kinetics Technologie, Holland
Société Chimique de la Grand Paroisse, Paris, France
Uhde GmbH, Dortmund, Germany
Voest-Alpine AG, Linz, Austria

3.2 Information material supplied by FAO, Rome:

a. Information issued by FAO:

Fertilizer Yearbook 1981

Agriculture toward 2000

Input requirements: Production, consumption, export/import
figures from fertilizer year 1970/71 to 81/82, by nutrients
and by type of fertilizers

Data of land use, by countries, 1971-1981

Current world fertilizer situation and outlook 1980/81-1986/87

Commission on fertilizers, eighth session, Rome,
31 January to 3 February, 1983

b. Information issued by Bureau of Mines:

Minerals Yearbook, 1981 (US Dept. of Interior) reprints

potash

sulphur

phosphate rock

4. UNIDO information material:

Internal working papers:

Opportunities for establishment of mini fertilizer plants in
developing countries

Potential for setting up mini fertilizer plants

World fertilizer situation 1975-1981 and outlook in the 1980s

Market study for mini fertilizer plants for developing countries

Appendix 1/1

5. Lahore Seminar

The seminar on mini fertilizer plants was organized by UNIDO, 15 - 20 November, 1982. Forty-five papers were presented. Out of these, 19 came from industrialized, 26 from developing countries. Thirty dealt with processes (out of these 11 presented new technological aspects) and 18 dealt with financial problems.

6. Technical conference on ammonia fertilizer technology for promotion of economic co-operation among developing countries, Beijing

The conference was organized by UNIDO, 13-28 March, 1982. Thirty-seven papers were presented. Seven of these come from industrialized and 30 from developing countries.

7. Others

Fertilizer Manual, UNIDO, Development and Transfer of Technology Series no. 13, ID/250, 1980

British Sulphur Corporation International Conference 1977, 1978

Fertilizer Industry, Noyes Data Corporation, New Jersey, USA, 1979

The Nitrogen Industry, edited by G.D. Honti, Budapest, 1976

Ammonia and Synthesis Gas, recent and energy-saving processes, edited by F.J. Brykowski, Noyes Data Corporation, New Jersey, USA, 1981

Second world-wide study on the fertilizer industry: 1975-2000, UNIDO/ICIS.81, 1978

International Petroleum Encyclopedia 1978, The Petroleum Publishing Co., Tulsa, USA

World Fertilizer Atlas, Sixth Edition, The British Sulphur Corporation Ltd., 1979

Phosphoric Acid, Outline of the Industry, The British Sulphur Corporation Ltd., 1980

Appendix 2/1 - Development of world fertilizer consumption

Table 1. World Consumption of Fertilizers,
by Regions 1975/76-1980/81
/Million metric tons N - P₂O₅ - K₂O/

Region	Nitrogenous					Phosphate					Potash							
	1975/76	76/77	77/78	78/79	79/80	80/81	1975/76	75/77	77/78	78/79	79/80	80/81	1975/76	76/77	77/78	78/79	79/80	80/81
<u>Developed Market Economies</u>	19.2	19.2	19.9	21.4	22.7	22.8	12.2	13.4	13.1	14.2	14.2	13.5	10.5	11.6	11.5	12.6	12.8	12.2
North America	10.0	10.2	9.7	10.6	11.2	11.6	5.2	5.6	5.2	5.7	5.5	5.5	5.0	5.5	5.3	6.0	6.0	6.0
Western Europe	8.0	8.4	8.8	9.4	10.0	9.8	5.1	5.5	5.6	6.1	6.1	5.6	4.6	5.0	5.2	5.5	5.7	5.3
Oceania	0.18	0.22	0.24	0.24	0.26	0.27	0.98	1.11	1.18	1.28	1.32	1.2	0.19	0.23	0.23	0.25	0.24	0.22
Others	0.98	1.25	1.10	1.14	1.22	1.12	1.00	1.12	1.15	1.20	1.26	1.16	0.72	0.79	0.82	0.87	0.88	0.67
<u>Developing Market Economies</u>	7.1	8.52	9.27	10.1	11.1	11.27	3.8	4.55	5.15	5.56	6.00	6.54	1.52	2.18	2.6	2.90	3.07	3.45
Africa	0.44	0.27	0.47	0.49	0.55	0.69	0.36	0.4	0.38	0.39	0.39	0.52	0.19	0.20	0.22	0.23	0.22	0.25
Latin America	1.88	2.25	2.51	2.46	2.67	2.94	1.70	2.0	2.21	2.29	2.44	2.76	0.93	1.12	1.39	1.48	1.58	1.86
Near East	1.32	1.39	1.56	1.64	1.81	1.82	0.69	0.84	0.96	0.97	1.13	1.05	0.03	0.04	0.04	0.05	0.06	0.08
Far East	3.70	4.25	5.0	5.5	6.24	6.61	1.07	1.29	1.59	1.91	2.04	2.21	0.65	0.81	0.93	1.14	1.20	1.26
Others	0.01	0.21	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<u>Centrally Planned Economies</u>	16.1	16.5	20.4	22.2	23.1	22.52	2.1	2.4	10.23	10.80	10.87	11.43	2.1	2.1	2.1	2.2	2.1	2.6
Asia	4.8	5.2	8.7	10.03	11.3	12.83	1.48	1.57	2.09	2.32	2.21	2.92	0.40	0.41	0.25	0.37	0.51	0.58
Eastern Europe	11.5	11.3	11.7	12.19	12.0	12.69	7.61	7.82	8.14	8.48	8.66	8.51	8.75	8.9	8.5	8.6	7.6	8.00
<u>All Developed Countries</u>	30.7	31.1	31.5	33.6	34.7	35.5	19.8	21.2	21.1	22.7	22.9	22.0	19.2	20.5	20.0	21.2	20.4	20.2
<u>All Developing Countries</u>	12.1	13.7	18.1	20.1	22.6	24.8	5.1	6.1	7.2	7.2	8.2	9.5	2.2	2.6	2.2	3.2	3.6	4.0
<u>World Total</u>	42.2	45.0	49.8	53.7	57.3	60.3	25.2	27.3	28.3	30.6	31.1	31.5	21.4	23.1	22.2	24.4	24.0	24.20

Sources: FAO Fertilizer Yearbooks 1979, 1980, 1981

FAO /USING/ World Bank Working Group on Fertilizers, June 1982

Table 2. World Fertilizer Consumption Growth Rates, by Regions
1975/76-1980/81

[illegible]

x/ Including Asia from Centrally Planned Economies

Table 2 /cont'd/

P H O S P H A T E /cont'd/					
Annual growth rates /per cent/					
	1976/77	1977/78	1978/79	1979/80	1980/81
All developing countries	15.1	18.0	2.7	3.8	15.2
Africa	11.1	-5.3	2.6	0.0	33.3
Latin America	17.6	10.5	3.6	7.0	13.1
Near East	21.7	14.3	1.0	16.5	7.6
Far East x/	12.2	28.7	14.9	0.5	20.7
World Total	8.3	4.4	7.4	1.6	1.3

P O T A S H					
All developed countries	6.8	-2.5	6.0	-3.2	-1.0
North America	10.0	-3.8	13.2	0.0	0.0
Western Europe	8.7	4.0	5.8	3.6	-7.0
Eastern Europe	1.7	-4.7	1.2	-13.2	11.1
All Developing countries	18.2	11.5	10.3	12.5	11.1
Africa	5.3	10.0	4.5	-4.5	13.6
Latin America	20.4	24.1	6.5	6.8	17.0
Near East	33.3	0.0	25.0	20.0	33.3
Far East x/	16.2	-3.4	28.0	13.2	7.6
World Total	7.9	-0.2	6.6	-1.7	0.8

Source: FAO Fertilizer Yearbook, 1981.

FAO /UNIDO/ World Bank Working Group on Fertilizers, June 1982.

x/ Including Asia from Centrally Planned Economies

Appendix 3/1 - Methods used for economic evaluation in the study

(Comparison of investment and production cost for mini and big plants

- in a developed site (West-Europe)
- in developing sites (seaside and remote location)

Introduction

If an economic comparison is made of ammonia production e.g. in a large single train plant (1000-1500 tpd) with a smaller plant (say, 200 tpd) and considering only technical factors then the conclusion may well be reached that the specific production cost per ton of product is lower in the larger plant. This will be due to the economies of scale in equipment costs and increased energy efficiencies. However, such comparisons ignore a number of factors and possible external constraints which will affect the plant's construction and operation and thereby alter the true economics of production.

Smaller capacity plants are quicker to build and will generally reach their design output in a much shorter time after initial plant start-up. The time saved may well be 2-3 years in total. Longer construc-

tion time means higher costs of pre-operating interest and a deferment of the date when natural resources or locally available feedstocks can be profitably converted into product and markets can begin to be satisfied. Meeting the technical and infrastructure needs of a large plant can also impose undue burdens upon existing infrastructure particularly in developing countries. Most types of fertilizer plant require a large source of fresh water to operate efficiently and product must be removed quickly from the plant if costs of maintaining inventories are not to become excessive. Specialized technical staff for the operation of complex process facilities will normally need to be brought into the area in which the plant is to be built and, depending on the local availability of skilled and qualified manpower, a high proportion of the staff in the initial years of operation may well be expatriates. The need to accommodate and support a large expatriate staff must be taken into account and may result in undue extra costs and burdens on the social infrastructure in a developing country e.g. housing, schools, hospitals.

Amidst all the arguments on the relative economics of small and large plants it must not be forgotten that the ultimate aim of any plant is to satisfy the existing or projected demand for its product. Where a reasonably large local demand already exists for a product then the choice of plant size will usually be based upon satisfying this demand with its projected growth over some reasonable period of time. Substitution of fertilizer imports with local product is usually adequate justification for the plant but the necessity to consider the economics of production then exists in order to determine whether imported products may be cheaper and whether product initially surplus to existing demand can be profitably sold in other markets.

The term "economic size" is usually interpreted in the context of process plants to mean the size beyond which unit cost of production would cease to show any marked decrease. Various factors will affect this "break-point" for any particular project situation and the eventual choice of plant size must be a balanced decision taking into account firstly the market situation and secondly the results of evaluating capacity related economic factors.

The economies achieved by large plants in industrialized countries are rarely achievable in De-

veloping Countries. However, smaller plants in developing countries can, if properly conceived and operated, produce economies which will approach those of large plants in Industrialized Countries. Therefore when taking into account savings in foreign exchange and the advantages of security and stability of supply, a plant can be justified at much lower capacity than would be so in the Developed World.

The question whether a minor or a big plant should be established in a developing country and where it should be installed is not only a function of the local market, the availability of raw materials, the specific investment and production costs, but quite a number of other factors must be taken into consideration, too.

Such points are, for example:

- The distance between the deposits of the raw material and the area of utilization;
- Conditions for the infrastructure, utility provisions, erection and operating personnel availability etc.;
- Transport and storage facilities;
- Quality and quantity of the local raw materials available;

- Market conditions, transport facilities of the finished product etc.

The investment and operating costs of the plants to be established, on the other hand is a function of the following factors:

- capacity;
- technology;
- characteristics of the site;
- local laws, technical, economic and other prevailing rules and regulations.

In order to compare the economic value of the different possible solutions of the same supply problem the following method is applied.

Summary of the methodology adopted

Based on conceptual deliberations with the methodological description and the detailed calculations, the total investment costs for a plant in an industrially developed country were established from the battery limit investment costs. The investment cost for the same in a developing country were derived by application of factors. The factors used are given in the Appendix 3/1 referred to.

As the projects in every case have been examined for identical site conditions, it is necessary to indicate the local conditions defined by the denominations /developed site, seaside location, remote location/.

Developed site - West Europe

Means a site with developed infrastructure and high technical background, where a staff of well-trained experts and an established logistic system are available.

Developing site: seaside location

Means a site where the infrastructure has to be partly developed. This and the time necessary for its realization must be taken into account as a cost-increasing factor. Transport facilities are restricted but a sea or river harbour is available. Construction and operation are to be performed partly by less skilled labour.

Developing site: remote location

Means a continental /inner/ site where no infrastructure is existing and in lack of a highway/railway network, transport difficulties should be reckoned with. The realization period is prolonged, partly by the former factors, partly by unskilled and unexperienced labour. All these justify a further increase of costs.

When establishing the factors used for the investment cost estimation on the previously defined sites, factors like: customs prescription, risks, differing transport and financing conditions etc., are not considered, since these may only be estimated in knowledge of the actual conditions; their generalization does not seem reasonable.

Several studies deal with the estimation of factors necessary for establishing the investment cost requirements with plants to be realized in developing countries. The most detailed evaluation method among them is given by the study of the Gulf Organization for Industrial Consulting /1/, it compares, by a weighting-evaluating system for every factor, an investment being realized in three types of developing countries on different development levels, to the investment costs of a similar object in the USA.

The results, as compared to USA investment costs, are:

- 1./ For a "relatively developed" developing country factor: 1.35
- 2./ For a "less developed" developing country factor: 2.10
- 3./ For a quite underdeveloped country, factor: 3.05

These factors, however, consider not only the total investment cost but also the contracting and financial possibilities.

/1/ Anon: Construction, production and distribution cost of petrochemical projects.
GOIC Seminar, Doha, Qatar, 20th Sept. 2nd Oct. 1979.

In the study of the UNIDO/OPEC found the following statement /1/.

Location factors: U.S. Gulf Coast	= 1.0
Latin America	= 1.3
Mid-East and China	= 1.5
Africa and Asia	= 2.0

In an 1978 UNIDO paper /2/, it can be found that the local factors are very difficult to estimate. It is mentioned that the TVA calculations generally consider a factor of 1.25 but many other authors think it to be low.

The factor used in this paper for an ammonia-urea plant is

for a site with some infrastructure	1.35
for a remote location	1.74

A factor of practically the same value is considered in a paper elaborated likewise by W.F. Sheldrick /3/ for a 1000 t/d ammonia and 1700 t/d urea plant are estimated

/1/ Anon: Opportunities for cooperation among developing countries for the establishment of petrochemical industries.
UNIDO/OPEC Fund Seminar, Vienna, 7-9 March, 1983

/2/ Anon: W.F. Sheldrick: Investment and production cost of fertilizers
UNIDO, 2nd Cons.Meeting on Fert.Ind., Innsbruck, Austria, 6-10 Nov. 1978

/3/ Anon: W.F. Sheldrick: Investment and production costs for fertilizers.
FAO Commission on Fertilizers Bth Session, Rome, 31.Jan. - 3.Febr., 1983

as follows:

developed site	1.0 /231 MDollar/
developing site	
/some infrastructure/	1.4 /323 MDollar/
developing site	
/remote location/	1.75 /405 MDollar/

In this study the following factors for the total general investment costs are applied:

small plants: seaside location:	1.27 - 1.29
remote location:	1.43 - 1.50
big plants: seaside location:	1.47 - 1.49
remote location:	1.91 - 1.93

Investment costs

The first phase of the economical evaluation is the examination of the capital expenditure necessary for the fulfilment of a given requirement by domestic production. The amount of capital needed influences of course also the production costs. When establishing the total investment costs for the objects examined, the following procedure has been followed:

Developed siteA) Total investment cost:

To the cost requirement calculated within the battery limit, we added the off-sites costs to be expected; the amount of it makes, according to literature data and our own experiences, abt. 30 per cent of the full investment cost. Both the battery limit and off-sites costs were broken down into equipment and local costs. This breakdown is based, within the battery limits, on the detailed cost calculation but, generally, the proportion may be estimated to be 70: 30 per cent.

Within the off-site costs, the breakdown has been estimated - on the basis of experience - to be as follows:

equipment 40 per cent

local cost..... 60 per cent

We already established total investment cost has been broken down into the following cost factors (based on calculation and proportions given by experience).

B/ Total investment cost

- licence, know-how /percentage within battery limits/
- engineering /percentage within battery limits +
+ 3 per cent off-sites cost/
- equipment /costs for battery limit plus offsite
equipment, from which the extra given
licence, know-how and engineering costs
have been subtracted/
- site preparation etc. covers preparation,
civil work and other costs

Developing site

the investment costs to be expected may be derived from the costs estimated on the basis of developed country /i.e. West-Europe/, considering different factors. The factor values characterize those condition differences increasing the costs which will - up to our opinion - influence the establishment of a small or big plant, resp. on different sites of developing countries and which cannot be calculated in a concise manner.

For the total investment costs calculated with the different estimated factors, the following average factors were found:

small plants - seaside location	1.27 - 1.29
remote location	1.43 - 1.50

big plants - seaside location	1.47 - 1.49
remote location	1.91 - 1.93

Detailed indications of the factors used in the calculations are given in the following table. /A 3/1.1/ The investment costs have been estimated on the price level for the year 1983.

Production costs

The production costs have been calculated for 1 ton of product, with consideration of the capacity given in t/d and the on-stream factor.

The on-stream factor is: for a West-Europe realization

with all plant sizes	90 per cent
for developing countries	
with small plants	90 per cent
with big plants	75 per cent

The basis for material and energy costs is the specific requirement determined by the technology; labour costs have been calculated on basis of the necessary yearly staff. The costs proportional to the means (fixed costs) are a function of the investment costs. Prices and costs factors utilized have been summarized in an extra table.

Factors used in estimation for investment costs

Developed site		Developing site			
West-Europe		Seaside location		Remote location	
		miniplant	big plant	miniplant	big plant
<u>battery_limit</u>					
- equipment cost	1 x	+8% transport cost		+10% transport cost	
- local cost	1 x	x 1,3	x 1,5	x 1,5	x 2,0
<u>off-site</u>					
- equipment cost	1 x	x 1,5	x 2,0	x 2,0	x 3,0
		+8 transport cost		+10% transport cost	
- local cost	1 x	x 1,5	x 2,0	x 2,0	x 3,0

Costs calculated for 1 ton of product have been increased by the sum of R.O.I. calculated likewise for 1 t (15 per cent). Costs on the basic materials have not been shown among the materials themselves but in consideration of the price ranges given for the sites, for the value increased by R.O.I.

According to the supposition, a plant should only be founded in a developing country if the basic materials occur in the country; thus, the unit prices of the basic materials have not simply been entered into the calculation on international market prices but also at an estimated value representing the costs of local extraction. Only sulphur has been considered to form an exception since it cannot be taken as usual that raw phosphate and sulphur occur simultaneously, on one site.

The value thus found represents the product value at the factory gate, to be still increased by distribution costs up to the end user. The magnitude of distribution costs is determined by the area to be furnished which again depends on the plant capacity.

The distribution costs have been estimated, with small plants, for a supply region of 100 km in diameter and with big plants, for a supply area of 300 km in diameter. Here, as a matter of fact, we had to rely on data from the literature. These costs may be estimated with a small plant at 15 \$/t and with big plants, at 60 \$/t.

Both the importance of the supply region and the distribution costs for 1 t of product depend on the local conditions and on the specific consumption of nutrients used for 1 ha of soil; therefore, considerable scattering of these costs may be imagined.

The costs on 1 t of product so far summarized are characteristic for the costs at the end users /farm-gate price/, without considering the application costs; we have not concentrated on these costs since they are identical whether the product comes from a small or from a big plant or even if it is an imported fertilizer.

The farm-gate price calculated from the complexes on 1 t of finished fertilizer product may be compared to the costs of 1 t of imported fertilizer of equal quality, also at farm-gate price.

The costs of the latter have been determined

starting from the costs of 1 t of product (nitrogen fertilizer) manufactured in a European big plant, out of natural gas (with a heat price of 5.9 and 11.8 \$/Gcal), increased by sea transport charges (in average, 70 \$/t), and in case of remote location, by the land freight charges (in average, say 25 \$/t) plus the usual distribution costs for a region of identical dimension than that of the home production.

Further, we considered as characteristic the total investment costs on 1 t, with the fertilizer plants of different capacities and different basic materials (the specific investment cost) which have been found by dividing the total investment costs by the yearly production figures, while taking into calculation the on-stream factors.

Unit prices, capital-related and labour-related cost

	<u>Developed site</u>		<u>Developing site</u>	
	West-Europe		Seaside	Remote location
<u>Materials:</u>				
Natural gas (8500 kcal/m ³)	\$/10 ³ m ³	30, 50, 100, 150	15, 30, 50, 100	
	\$/Gcal	3.5, 5.9, 11.8, 17.6	1.8, 3.5, 5.9, 11.8	
Fuel oil (10 000 kcal/kg)	\$/t	150, 180	120	150
	\$/Gcal	15, 18	12,	15
Coal (2200 kcal/kg)	\$/t	15, 30, 50	10, 20, 30	
	\$/Gcal	6.8, 13.6, 22.7	4.6, 9.1, 13.6	
Phosphate rock (32.5%P ₂ O ₅)	\$/t	50, 70	15, 30, 50	
Sulphur	\$/t	90	100	
Potash	\$/t	70	-	
Lime	\$/t	25	25	
Coating agent	\$/t	60	60	
Anti-caking agent	\$/t	1000	1000	
MgO	S/t	250	250	
Platina	\$/kg	13200	13200	

Utilities:^x

Power	\$/MWh	30	30
Steam	\$/t	15	15
BFW	\$/10 ³ m ³	160	160
BFW /demineralized/	\$/10 ³ m ³	500	500
Cooling water	\$/10 ³ m ³	20	20
Process water	\$/10 ³ m ³	12	12

Labor	\$/men/y	15 000	8 000
Overhead expenses % of total labour cost		150	250
Depreciation % of total investment cost		10	10
Maintenance % of total investment cost		3	4
Insurance and property taxes % of total investment cost		2	3
R.O.I.	%	15	15

^xNo difference has been made in the prices of utilities for developed and developing countries, the investment cost of utility objects having been increased by factors characteristic for the site, in the case of developing sites.

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Appendix 3/1

Table 1-1.1

Product: Ammonia
Raw material: natural gas
Location: Developed site, West-Europe

Capacity		t/d	150	250	1000
A./	<u>Total investment cost</u>	M\$	29,0	39,0	145,0
	-battery limit	"	20,0	27,0	100,0
	-equipment	"	14,0	19,0	70,0
	-local cost	"	6,0	8,0	30,0
	-off-sites	"	9,0	12,0	45,0
	-equipment	"	3,6	4,8	18,0
	-local cost	"	5,4	7,2	27,0
B./	<u>Total investment cost</u>	M\$	29,0	39,0	145,0
	-licence, know-how	"	0,4	0,6	2,0
	-engineering	"	3,9	5,3	19,6
	-equipment	"	13,3	17,9	66,4
	-site preparation, civil work, erection	"			
	at site, other costs	"	11,4	15,2	57,0

Product: AmmoniaRaw material: natural gasLocation: Developing site, Seaside

Capacity		t/d	150	200	1000
A./ Total investment cost					
-battery limit	M\$		37,0	49,6	213,5
-equipment	"		23,0	31,0	120,6
-local cost	"		15,2	20,5	75,6
-off-sites	"		7,8	10,5	45,0
-equipment	"		14,0	18,6	92,9
-local cost	"		5,8	7,8	38,9
	"		8,2	10,8	54,0
B./ Total investment cost					
-licence, know-how	M\$		37,0	49,6	213,5
-engineering	"		0,5	0,7	3,0
-equipment	"		4,8	6,5	26,7
-site preparation, civil work, erection at site, other costs	"		15,9	21,1	84,8
	"		15,9	21,3	99,0

Product: AmmoniaRaw material: natural gasLocation: Developing site, Remote

Capacity		t/d	150	250	1000
A./	<u>Total investment cost</u>	M\$	43,0	58,0	277,4
	-battery limit	"	24,4	33,0	137,0
	-equipment	"	15,4	20,9	77
	-local cost	"	9,0	12,1	60
	-off-sites	"	18,6	25,0	140,4
	-equipment	"	7,9	10,6	59,4
	-local cost	"	10,7	14,4	81,0
B./	<u>Total investment cost</u>	M\$	43,0	58,0	277,4
	-licence, know-how	"	0,6	0,9	4,0
	-engineering	"	5,4	7,3	33,2
	-equipment	"	17,3	23,3	99,2
	-site preparation, civil work, erection at site, other costs	"	19,7	26,5	141,0

Product: AmmoniaRaw material: fuel oilLocation: Developed site, West-Europe

Capacity		t/d	150	250	1000
A./	<u>Total investment cost</u>	M\$	33,0	45,0	167,0
	-battery limit	"	23,0	31,0	115,0
	-equipment	"	16,1	21,7	80,5
	-local cost	"	6,9	9,3	34,5
	-off-sites	"	10,0	14,0	52,0
	-equipment	"	4,0	5,6	20,8
	-local cost	"	6,0	8,4	31,2
B./	<u>Total investment cost</u>	M\$	33,0	45,0	167,0
	-licence,know-how	"	0,5	0,6	2,3
	-engineering	"	4,5	6,1	22,6
	-equipment	"	15,1	20,6	76,4
	-site preparation, civil work,erection				
	at site,other costs	"	12,9	17,7	65,7

Product: Ammonia
Raw material: fuel oil
Location: Developing site, Seaside

Capacity	t/d	150	250	1000
A./ Total investment cost				
-battery limit	M\$	42,0	57,0	246,0
-equipment	"	26,5	35,5	130,8
-local cost	"	17,5	23,4	87,0
-off-sites	"	9,0	12,1	51,8
-equipment	"	15,5	21,5	107,2
-local cost	"	6,5	9,0	45,0
	"	9,0	12,5	62,2
B./ Total investment cost				
-licence, know-how	M\$	42,0	57,0	246,0
-engineering	"	0,6	0,8	3,5
-equipment	"	5,4	7,4	30,8
-site preparation, civil work, erection at site, other costs	"	10,0	24,2	97,7
	"	18,0	24,6	114,0

Product: AmmoniaRaw material: fuel oilLocation: Developing site, Remote

Capacity		t/d	150	250	1000
<u>A./ Total investment cost</u>					
-battery limit	M\$		49,0	67,0	320,0
-equipment	"		28,0	33,0	157,8
-local cost	"		17,7	24,0	88,6
-off-sites	"		10,3	14,0	69,2
-equipment	"		21,0	29,0	162,2
-local cost	"		9,0	12,3	68,6
	"		12,0	16,7	93,6
<u>B./ Total investment cost</u>					
-licence,know-how	M\$		49,0	67,0	320,0
-engineering	"		0,8	0,9	4,6
-equipment	"		6,2	8,4	38,2
-site preparation, civil work,erection at site,other costs	"		19,7	27,0	114,4
	"		22,3	30,7	162,8

Product: AmmoniaRaw material: coalLocation: Developed site, West-Europe

Capacity	t/d	150	250	1000
<u>A./ Total investment cost</u>				
-battery limit	M\$	46,0	62,0	232,0
-equipment	"	32,0	43,0	160,0
-local cost	"	22,4	30,0	112,0
-off-sites	"	9,6	13,0	48,0
-equipment	"	14,0	19,0	72,0
-local cost	"	5,6	7,6	28,8
	"	8,4	11,4	43,2
<u>B./ Total investment cost</u>				
-licence, know-how	M\$	46,0	62,0	232,0
-engineering	"	0,6	0,9	3,2
-equipment	"	6,2	8,4	31,4
-site preparation, civil work, erection at site, other costs	"	21,2	28,3	106,2
	"	18,0	24,4	91,2

Product: AmmoniaRaw material: coalLocation: Developed site, Seaside

Capacity		t/d	150	250	1000
A./ Total investment cost					
-battery limit	M\$		58,0	78,8	341,5
-equipment	"		36,5	49,4	193,0
-local cost	"		24,1	32,4	121,0
-off-sites	"		12,4	17,0	72,0
-equipment	"		21,5	29,4	148,5
-local cost	"		9,0	12,3	62,1
	"		12,5	17,1	86,4
B./ Total investment cost					
-licence, know-how	M\$		58,0	78,8	341,5
-engineering	"		0,8	1,2	4,8
-equipment	"		7,5	10,3	42,8
-site preparation, civil work, erection at site, other costs	"		24,8	33,2	135,5
	"		24,9	34,1	158,4

Product: AmmoniaRaw material: coalLocation: Developing site, Remote

Capacity		t/d	150	250	1000
A./ Total investment cost					
-battery limit	M\$		63,0	92,0	444,0
-equipment	"		39,0	52,5	219,4
-local cost	"		24,6	33,0	123,4
-off-sites	"		14,4	19,5	96,0
-equipment	"		29,0	39,5	224,6
-local cost	"		12,2	16,7	95,0
	"		16,8	22,8	129,6
B./ Total investment cost					
-licence, know-how	M\$		63,0	92,0	444,0
-engineering	"		0,9	1,4	6,4
-equipment	"		8,5	11,6	53,1
-site preparation, civil work, erection	"		27,4	36,7	153,9
at site, other costs	"		31,2	42,3	225,6

Product: Nitric acid

Raw material:

Location: Developed site, West-Europe

Capacity	t/d	273	455	1822
A./ <u>Total investment cost</u>				
-battery limit	M\$	14,2	23,6	94,7
-equipment	"	9,8	16,3	65,3
-local cost	"	6,7	11,4	45,7
-off-sites	"	3,1	4,9	19,6
-equipment	"	4,4	7,3	29,4
-local cost	"	1,8	2,9	11,8
	"	2,6	4,4	17,6
B./ <u>Total investment cost</u>				
-licence, know-how	M\$	14,2	23,6	94,7
-engineering	"	0,3	0,5	2,0
-equipment	"	1,1	1,9	7,6
-site preparation,	"	7,1	11,9	47,9
civil work, erection				
at site, other costs	"	5,7	9,3	37,2

Product: Nitric acidRaw material:Location: Developing site, Seaside

Capacity		t/d	273	455	1822
A./	<u>Total investment cost</u>	M\$	18,0	30,0	139,5
	-battery limit	"	11,2	18,7	78,8
	-equipment	"	7,2	12,3	49,4
	-local cost	"	4,0	6,4	29,4
	-off-sites	"	6,8	11,3	60,7
	-equipment	"	2,9	4,7	25,5
	-local cost	"	3,9	6,6	35,2
B./	<u>Total investment cost</u>	M\$	18,0	30,0	139,5
	-licence, know-how	"	0,4	0,6	3,0
	-engineering	"	1,4	2,4	11,2
	-equipment	"	0,3	14,0	60,7
	-site preparation, civil work, erection	"			
	at site, other costs	"	7,9	13,0	64,6

Product: Nitric acidRaw material:Location: Developing site, Remote

Capacity	t/d	273	455	1822
A./ Total investment cost				
-battery limit	M\$	21,3	35,1	181,2
-equipment	"	12,1	19,9	89,5
-local cost	"	7,4	12,5	50,3
-off-sites	"	4,7	7,4	39,2
-equipment	"	9,2	15,2	91,7
-local cost	"	4,0	6,4	38,9
	"	5,2	8,8	52,8
B./ Total investment cost				
-licence, know-how	M\$	21,3	35,1	181,2
-engineering	"	0,5	0,8	4,0
-equipment	"	1,7	2,8	14,5
-site preparation, civil work, erection at site, other costs	"	9,2	15,3	70,7
	"	9,9	16,2	92,0

Product: Ammonium nitrateRaw material:Location: Developed site, West-Europa

Capacity	t/d	355	591	2364
A./ <u>Total investment cost</u>				
-battery limit	M\$	10,9	16,2	48,7
-equipment	"	7,5	11,2	33,6
-local cost	"	5,3	7,8	23,5
-off-sites	"	2,2	3,4	10,1
-equipment	"	3,4	5,0	15,1
-local cost	"	1,4	2,0	6,0
	"	2,0	3,0	9,1
B./ <u>Total investment cost</u>				
-licence, know-how	M\$	10,9	16,2	48,7
-engineering	"	0,2	0,3	1,0
-equipment	"	1,4	2,0	5,9
-site preparation, civil work, erection	"	5,1	7,5	22,6
at site, other costs	"	4,2	6,4	19,2

Product: Ammonium nitrateRaw material:Location: Developing site, Seaside

Capacity		t/d	355	591	2364
A./ Total investment cost					
-battery limit	M\$		13,9	20,5	71,8
-equipment	"		8,6	12,8	40,8
-local cost	"		5,7	8,4	25,4
-off-sites	"		2,9	4,4	15,2
-equipment	"		5,3	7,7	31,2
-local cost	"		2,3	3,2	13,0
	"		3,0	4,5	18,2
B./ Total investment cost					
-licence, know-how	M\$		13,9	20,5	71,8
-engineering	"		0,3	0,4	1,5
-equipment	"		1,6	1,9	8,2
-site preparation,	"		6,1	9,3	28,7
civil work, erection					
at site, other costs	"		5,9	8,9	33,4

Product: Ammonium nitrate
Raw material:
Location: Developing site, Remote

Capacity	t/d	355	591	2364
A./ Total investment cost				
-battery limit	M\$	16,2	24,1	93,2
-equipment	"	9,1	13,7	46,1
-local cost	"	5,8	8,6	25,9
-off-sites	"	3,3	5,1	20,2
-equipment	"	7,1	10,4	47,1
-local cost	"	3,1	4,4	19,8
	"	4,0	6,0	27,3
B./ Total investment cost				
-licence,know-how	M\$	16,2	24,1	93,2
-engineering	"	0,3	0,5	2,0
-equipment	"	1,9	2,7	10,3
-site preparation, civil work,erection at site,other costs	"	6,7	9,8	33,4
	"	7,3	11,1	47,5

Product: UreaRaw material:Location: Developed site, West-Europe

Capacity		t/d	260	440	1700
<u>A./ Total investment cost</u>					
-battery limit	M\$	"	15,7	23,8	69,6
-equipment	"	"	10,8	16,4	48,0
-local cost	"	"	7,6	11,5	33,6
-off-sites	"	"	3,2	4,9	14,4
-equipment	"	"	4,9	7,4	21,6
-local cost	"	"	2,0	3,0	8,6
	"	"	2,9	4,4	13,0
<u>B./ Total investment cost</u>					
-licence,know-how	M\$	"	15,7	23,8	69,6
-engineering	"	"	0,3	0,5	1,4
-equipment	"	"	1,7	2,6	7,5
-site preparation, civil work,erection at site,other costs	"	"	7,6	11,4	33,3
	"	"	6,1	9,3	27,4

Product: UreaRaw material:Location: Developing site, Seaside

Capacity		t/d	260	440	1700
A./	<u>Total investment cost</u>	M\$	20,0	30,3	102,5
	-battery limit	"	12,4	18,8	57,9
	-equipment	"	8,2	12,4	36,3
	-local cost	"	4,2	6,4	21,6
	-off-sites	"	7,6	11,5	44,6
	-equipment	"	3,2	4,9	18,6
	-local cost	"	4,4	6,6	26,0
B./	<u>Total investment cost</u>	M\$	20,0	30,3	102,5
	-licence, know-how	"	0,4	0,7	2,1
	-engineering	"	2,1	3,2	10,5
	-equipment	"	3,9	13,4	41,3
	-site preparation, civil work, erection				
	at site, other costs	"	8,6	13,0	48,6

Product: UreaRaw material:Location: Developing site, Remote

Capacity		t/d	260	440	1700 -
<u>A./ Total investment cost</u>					
-battery limit	M\$		23,4	35,5	133,2
-equipment	"		13,2	20,1	65,8
-local cost	"		8,4	12,7	37,0
-off-sites	"		4,8	7,4	28,8
-equipment	"		10,2	15,4	67,4
-local cost	"		4,4	6,6	28,4
	"		5,8	8,8	39,0
<u>B./ Total investment cost</u>					
-licence, know-how	M\$		23,4	35,5	133,2
-engineering	"		0,5	0,8	2,8
-equipment	"		2,4	3,6	13,3
-site preparation, civil work, erection at site, other costs	"		9,9	14,9	49,3
	"		10,6	16,2	67,8

Product: Sulphuric acidRaw material: sulphurLocation:

Capacity

A./Total investment cost

-battery limit
-equipment
-local cost
-off-sites
-equipment
-local cost

t/d

M\$

Developed site
West-Europe

200

Developing site
Seaside

200

Developing site
Remote

200

14,4
8,2
5,2
3,0
6,2
2,6
3,6

B./ Total investment cost

-licenap, know-how
-engineering
-equipment
-site preparation,
civil work, erection
at site, other costs

M\$

"

"

"

"

9,7

0,2

1,4

4,3

3,8

12,3

0,3

1,8

4,9

5,3

14,4

0,3

2,0

5,5

6,6

Product: Sulphuric acidRaw material: sulphurLocation:

Location:	Capacity	t/d	Developed site		Developing site	
			West-Europe	Seaside	Remote	
A./Total investment cost		M\$	600	600	600	
-battery limit		"	22,5	28,6	33,5	
-equipment		"	15,5	17,8	18,9	
-local cost		"	11,0	11,9	12,1	
-off-sites		"	4,5	5,9	6,8	
-equipment		"	7,0	10,8	14,6	
-local cost		"	2,8	4,5	6,2	
		"	4,2	6,3	8,4	
B./ Total investment cost		M\$	22,5	28,6	33,5	
-licence, know-how		"	0,5	0,7	0,8	
-engineering		"	3,4	4,1	4,6	
-equipment		"	9,9	11,4	12,9	
-site preparation, civil work, erection at site, other costs		"	8,7	12,4	15,2	

Product: Phosphoric acid /100% P_2O_5 /

Raw material: phosphate rock

Location:

Location:			<u>Developed site</u>		<u>Developing site</u>	
			<u>West-Europe</u>	<u>Seaside</u>	<u>Remote</u>	
Capacity	t/d		200	200	200	
A./ <u>Total investment cost</u>	Mr		23,8	30,3	35,5	
-battery limit	"		16,4	18,8	20,1	
-equipment	"		11,5	12,4	12,7	
-local cost	"		4,9	6,4	7,4	
-off-sites	"		7,4	11,5	15,4	
-equipment	"		3,0	4,9	6,6	
-local cost	"		4,4	6,6	8,8	
B./ <u>Total investment cost</u>	Mr		23,8	30,3	35,5	
-license, know-how	"		0,5	0,6	0,8	
-engineering	"		4,2	5,0	5,6	
-equipment	"		9,8	11,7	12,7	
-site preparation, civil work, erection at site, other costs	"		9,3	13,0	16,4	

Product: SSP /18% P₂O₅/

Raw material: phosphate rock

Location:

Capacity	t/d	<u>Developed site</u>		<u>Developing site</u>	
		West-Europe	Seaside	Remote	Remote
		500	500	500	500
A./Total investment cost	M\$	4,4	5,7	6,6	6,6
-battery limit	"	3,0	3,5	3,7	3,7
-equipment	"	2,1	2,3	2,3	2,3
-local cost	"	0,9	1,2	1,4	1,4
-off-sites	"	1,4	2,2	2,9	2,9
-equipment	"	0,6	1,0	1,3	1,3
-local cost	"	0,8	1,2	1,6	1,6
B./Total investment cost	M\$	4,4	5,7	6,6	6,6
-license, know-how	"	0,1	0,1	0,2	0,2
-engineering	"	0,6	0,7	0,8	0,8
-equipment	"	2,0	2,5	2,6	2,6
-site preparation, civil work, erection at site, other costs	"	1,7	2,4	3,0	3,0

Product: TSP /46% P₂O₅/

Raw material:

Location:

Location:	Capacity	t/d	Developed site		Developing site	
			West-Europe	Seaside	Remote	
			500	500	500	
A./Total investment cost		M\$				
-battery limit		"	5,1	6,5	7,6	
-equipment		"	3,5	4,0	4,3	
-local cost		"	2,5	2,7	2,8	
-off-sites		"	1,0	1,3	1,5	
-equipment		"	1,6	2,5	3,3	
-local cost		"	0,6	1,0	1,3	
		"	1,0	1,5	2,0	
B./ Total investment cost		M\$				
-licence,know-how		"	5,1	6,5	7,6	
-engineering		"	0,1	0,1	0,2	
-equipment		"	0,7	0,9	1,0	
-site preparation, civil work,erection at site,other costs		"	2,3	2,7	2,9	
		"	2,0	2,8	3,5	

Product: MAP /12% N + 52% P₂O₅/, or DAP /18% N + 46% P₂O₅/

MPK /19:19:19/

Raw material:

Location: Developed site, West-Europe

Capacity	t/d	375	1040
A./ Total investment cost			
-battery limit	M\$	8,1	12,5
-equipment	"	5,6	8,6
-local cost	"	3,9	6,0
-off-sites	"	1,7	2,6
-equipment	"	2,5	3,9
-local cost	"	1,0	1,6
	"	1,5	2,3
B./ Total investment cost			
-licence, know-how	M\$	8,1	12,5
-engineering	"	0,2	0,3
-equipment	"	1,3	1,8
-site preparation, civil work, erection	"	3,4	5,5
at site, other costs	"	3,2	4,9

Appendix 3/1

Table 2-1

Specific investment cost \$/t/y product

		<u>Developed site</u>	<u>Developing site</u>	
		West-Europe	Seaside	Remote
			location	
<u>Ammonia</u>				
	<u>Feedstock</u>			
<u>150 t/d</u>	nat.gas	580	740	860
	fuel oil	660	840	980
	coal	920	1160	1360
<u>250 t/d</u>	nat.gas	470	598	700
	fuel oil	542	687	807
	coal	747	950	1108
<u>1000t/d</u>	nat.gas	440	776	1010
	fuel oil	506	895	1164
	coal	703	1242	1615
<u>Nitric acid</u>				
	273 t/d	158	200	237
	455 t/d	157	200	234
	1822 t/d	158	279	362
<u>Ammonium nitrate</u>				
	355 t/d	93	119	138
	591 t/d	83	105	124
	2364 t/d	62	110	143
<u>Urea</u>				
	260 t/d	183	232	272
	440 t/d	164	209	245
	1700 t/d	124	219	285

Specific investment cost \$/t/y product

	<u>Developed site</u>	<u>Developing site</u>	
	West-Europe	Seaside	Remote location
<u>Sulphuric acid</u>			
<u>200 t/d</u>	147	186	218
<u>600 t/d</u>	113	143	168
<u>Phosphoric acid</u>			
200 t/d P ₂ O ₅	360	459	538
/370 t/d tel-quel/			
<u>SSP</u> 500 t/d	27	36	41
<u>TSP</u> 500 t/d	32	40	47
<u>MAP</u> 375 t/d	68	-	-
<u>DAP</u> 425 t/d	62	-	-
<u>NPK</u> 1040 t/d	39	-	-

Total investment costs of ammonia-urea complexes

			Developed site	Developing site	
			West- Europe	Seaside location	Remote location
<u>Urea 260 t/d</u>					
Feedstock: natural gas	NH ₃	M\$	29,0	37,0	43,0
	Urea	M\$	15,7	20,0	23,4
	Total	M\$	44,7	57,0	66,4
fuel oil	NH ₃	M\$	33,0	42,0	49,0
	Urea	M\$	15,7	20,0	23,4
	Total	M\$	48,7	62,0	72,4
coal	NH ₃	M\$	46,0	58,0	68,0
	Urea	M\$	15,7	20,0	23,4
	Total	M\$	61,7	78,0	91,4
<u>Urea 440 t/d</u>					
Feedstock: natural gas	NH ₃	M\$	39,0	49,6	58,0
	Urea	M\$	23,8	30,3	35,5
	Total	M\$	62,8	79,9	93,5
fuel oil	NH ₃	M\$	45,0	57,0	67,0
	Urea	M\$	23,8	30,3	35,5
	Total	M\$	68,8	87,3	102,5
coal	NH ₃	M\$	62,0	78,8	92,0
	Urea	M\$	23,8	30,3	35,5
	Total	M\$	85,8	109,1	127,5
<u>Urea 1700 t/d</u>					
Feedstock: natural gas	NH ₃	M\$	145,0	213,5	277,4
	Urea	M\$	69,6	102,5	133,2
	Total	M\$	214,6	316,0	410,6
fuel oil	NH ₃	M\$	167,0	246,0	320,0
	Urea	M\$	69,6	102,5	133,2
	Total	M\$	236,6	348,5	453,2
coal	NH ₃	M\$	232,0	341,5	444,0
	Urea	M\$	69,6	102,5	133,2
	Total	M\$	301,6	444,0	577,2

Total investment cost of ammonia-nitric acid-ammonium nitrate complexes

			Developed site West- Europe	Developing site Seaside location	Remote location
<u>Ammonium nitrate 355 t/d</u>					
Feedstock: natural gas	NH ₃	M\$	29,0	37,0	43,0
	HNO ₃	M\$	14,2	18,0	21,3
	AN	M\$	<u>10,9</u>	<u>13,9</u>	<u>16,2</u>
	Total	M\$	54,1	68,9	80,5
fuel oil	NH ₃	M\$	33,0	42,0	49,0
	HNO ₃	M\$	14,2	18,0	21,3
	AN	M\$	<u>10,9</u>	<u>13,9</u>	<u>16,2</u>
	Total	M\$	58,1	73,9	86,5
coal	NH ₃	M\$	46,0	58,0	68,0
	HNO ₃	M\$	14,2	18,0	21,3
	AN	M\$	<u>10,9</u>	<u>13,9</u>	<u>16,2</u>
	Total	M\$	71,1	89,9	105,5
<u>Ammonium nitrate 591 t/d</u>					
Feedstock: natural gas	NH ₃	M\$	39,0	49,6	58,0
	HNO ₃	M\$	23,6	30,0	35,1
	AN	M\$	<u>16,2</u>	<u>20,5</u>	<u>24,1</u>
	Total	M\$	78,8	100,1	117,2
fuel oil	NH ₃	M\$	45,0	57,0	67,0
	HNO ₃	M\$	23,6	30,0	35,1
	AN	M\$	<u>16,2</u>	<u>20,5</u>	<u>24,1</u>
	Total	M\$	84,8	107,5	126,2
coal	NH ₃	M\$	62,0	78,8	92,0
	HNO ₃	M\$	23,6	30,0	35,1
	AN	M\$	<u>16,2</u>	<u>20,5</u>	<u>24,1</u>
	Total	M\$	101,8	129,3	151,2
<u>Ammonium nitrate 2364 t/d</u>					
Feedstock: natural gas	NH ₃	M\$	145,0	213,5	277,4
	HNO ₃	M\$	94,7	139,5	181,2
	AN	M\$	<u>48,7</u>	<u>71,8</u>	<u>93,2</u>
	Total	M\$	288,4	424,3	551,8
fuel oil	NH ₃	M\$	167,0	246,0	320,0
	HNO ₃	M\$	94,7	139,5	181,2
	AN	M\$	<u>48,7</u>	<u>71,8</u>	<u>93,2</u>
	Total	M\$	310,4	457,3	594,4
coal	NH ₃	M\$	232,0	341,5	444,0
	HNO ₃	M\$	94,7	139,5	181,2
	AN	M\$	<u>48,7</u>	<u>71,8</u>	<u>93,2</u>
	Total	M\$	375,4	552,8	718,4

Total investment costs of phosphate

complexes

		Developed site	Developing site	
		site	Seaside	Remote
		West-Europe	location	
<u>SSP 500 t/d</u>				
H ₂ SO ₄	M\$	9,7	12,3	14,4
SSP ⁴	M\$	4,4	5,7	6,6
Total	M\$	14,1	18,0	21,0
<u>TSP 500 t/d</u>				
H ₂ SO ₄	M\$	22,5	28,6	33,5
H ₃ PO ₄	M\$	23,8	30,3	35,5
TSP ⁴	M\$	5,1	6,5	7,6
Total	M\$	51,4	65,4	76,6
<u>MAP 375 t/d</u>				
H ₂ SO ₄	M\$	22,5	28,6	33,5
H ₃ PO ₄	M\$	23,8	30,3	35,5
MAP ⁴ /DAP/	M\$	8,1	10,3	12,1
Total	M\$	54,4	69,2	81,1
<u>DAP 425 t/d</u>				
H ₂ SO ₄	M\$	22,5	28,6	33,5
H ₃ PO ₄	M\$	23,8	30,3	35,5
NPK ⁴	M\$	12,5	16,0	18,6
Total	M\$	58,8	74,9	87,6

Specific investment costs of ammonia -nitric-acid-
ammonium nitrate, ammonia-urea complexes

Sp\$/t/y Ammonium-nitrate

	<u>Developed site</u>		<u>Developing site</u>	
	West-Europe		Seaside	Remote location
<u>Ammonium nitrate</u>				
<u>355 t/d</u>				
Feedstock:	nat.gas	462	588	688
	fuel oil	496	632	739
	coal	608	768	902
<u>591 t/d</u>				
Feedstock:	nat.gas	404	513	601
	fuel oil	435	551	647
	coal	522	663	775
<u>2364 t/d</u>				
Feedstock:	nat.gas	370	654	849
	fuel oil	398	704	914
	coal	481	850	1105

Sp\$/t/y urea

<u>Urea</u>				
<u>260 t/d</u>				
Feedstock: nat.gas	520		663	772
fuel oil	566		721	842
coal	717		907	1063
<u>440 t/d</u>				
Feedstock: nat.gas	433		551	644
fuel oil	475		602	707
coal	592		752	879
<u>1700 t/d</u>				
Feedstock: nat.gas	383		675	877
fuel oil	422		745	968
coal	538		950	1233

Specific investment costs of 1 t N in ammonia
- nitric acid - ammonium nitrate, ammonia-urea
complexes

Sp.I. \$/t N/y

Raw material: natural gas

Developing site

Seaside location Remote

Ammonium nitrate

355 t/d	1729	2024
591 t/d	1509	1768
2364 t/d	1924	2497

Urea

260 t/d	1441	1678
440 t/d	1198	1400
1700 t/d	1467	1907

Specific investment costs of phosphate complexes

Sp.I.\$/t/y

	<u>Developed site</u>	<u>Developing site</u>	
	West-Europe	Seaside	Remote location
<u>SSP</u>			
<u>500 t/d</u>	85	109	127
<u>TSP</u>			
<u>500 t/d</u>	312	396	464
<u>MAD</u>			
<u>375 t/d</u>	440	558	654
<u>DAP</u>			
<u>425 t/d</u>	390	494	579
<u>NPK</u>			
<u>1040 t/d</u>	171	262	306

Product: Ammonia

Raw material: natural gas

Location: Developed site, West-Europe

Capacity	t/d	150	250	1000
On-stream factor	%	90	90	90
Production	kt/y	50	83	330
Total investment cost	M\$	29,0	39,0	145
Production cost				
Materials	\$/t	8,0	8,0	8,0
Chemicals				

a./ Total materials	\$/t	8,0	8,0	8,0
Utilities	\$/t			
Power	"	26,5	-	2,2
Steam	"	-	-	-
BP//demineralized/	"	0,9	0,6	0,6
Cooling water	"	10,3	5,0	2,4
b./ Total utilities	\$/t	37,7	6,0	5,2
c./ Labour	\$/t	9,6	5,8	1,5
d./ Overhead expenses	\$/t	14,4	8,7	2,3
e./ Total/a+b+c+d/	\$/t	69,7	29,1	17,0
f./ Depreciation	\$/t	58,0	47,0	43,9
g./ Maintenance	\$/t	17,4	14,1	13,2
h./ Insurance and property taxes	\$/t	11,6	9,4	8,8
i./ Total /f+g+h/	\$/t	87,0	70,5	65,9
j./ Total production cost / e+i/	\$/t	156,7	99,6	82,9
k./ 15% R.O.I.	\$/t	87,0	70,5	65,9
l./ Total /j+k/	\$/t	243,7	170,1	148,8
m./ Feedstock costs				
1. 3,5\$ 10 ⁶ kcal	\$/t	26,3	29,4	25,2
/natural 2. 5,9 \$	\$/t	44,3	49,6	42,5
gas/ 3. 11,8 \$	\$/t	88,5	99,1	85,0
4. 17,6 \$	\$/t	132,0	147,8	126,7
n./ Product value /l+m/ at factory gate				
1.	\$/t	270,0	199,5	174,0
2.	\$/t	288,0	219,7	191,3
3.	\$/t	332,2	269,2	233,8
4.	\$/t	375,7	317,9	275,5
o./ Distribution cost	\$/t	-	-	-
p./ Farm-gate price /n+o/	\$/t	-	-	-
	\$/t			
	\$/t			
	\$/t			

Product: Urea

Raw material: natural gas

Location: Developed site, West-Europe

Capacity	t/d	260	440	1700
On-stream factor	%	90	90	90
Production	kt/y	86	145	560
Total investment cost	M\$	15,7	23,8	69,6
<u>Production cost</u>				
<u>Materials</u>	\$/t			
CO ₂		-	-	-
a./ Total materials	\$/t	-	-	-
<u>Utilities</u>	\$/t			
Power	"	4,5	4,2	3,9
Steam	"	13,8	13,5	12,6
BFW/demineralized/ Cooling water	"	1,4	1,4	1,2
Steam credit	"	-	-	- 0,8
b./ Total utilities	\$/t	19,7	19,1	16,9
c./ Labour	\$/t	3,5	2,1	0,5
d./ Overhead expenses	\$/t	5,3	3,2	0,8
e./ Total/a+b+c+d/	\$/t	28,5	24,4	18,2
f./ Depreciation	\$/t	18,3	16,4	12,4
g./ Maintenance	\$/t	5,5	4,9	3,7
h./ Insurance and property taxes	\$/t	3,7	3,3	2,5
i./ Total /f+g+h/	\$/t	27,5	24,6	18,6
j./ Total production cost / e+i/	\$/t	56,0	49,0	36,8
k./ 15% R.O.I.	\$/t	27,5	24,6	18,6
l./ Total /j+k/	\$/t	83,5	73,6	55,4
m./ Feedstock costs				
1. /NH ₃ /	\$/t	153,9	113,7	99,1
2.	\$/t	164,2	125,2	109,0
3.	\$/t	189,4	153,4	133,2
4.	\$/t	214,2	181,2	157,0
n./ Product value /l+m/ at factory gate				
1.	\$/t	237,4	187,3	154,5
2.	\$/t	247,7	198,8	164,4
3.	\$/t	272,9	227,0	188,6
4.	\$/t	297,7	254,8	212,4
o./ Distribution cost	\$/t	-	-	-
p./ Farm-gate price /n.o/	\$/t	-	-	-
	\$/t			
	\$/t			
	\$/t			

Product: Nitric acid

Raw material: natural gas

Location: Developed site, West-Europe

Capacity	t/d	273	455	1822
On-stream factor	%	90	90	90
Production	kt/y	90	150	600
Total investment cost	M\$	14,2	23,6	94,7
Production cost				
Materials	\$/t			
Platina		1,7	1,7	1,7
a./ Total materials	\$/t	1,7	1,7	1,7
Utilities	\$/t			
Power	"	0,4	0,4	0,4
Steam	"	-	-	-
BPW/demineralized/	"	-	-	-
Cooling water	"	2,2	2,2	2,2
BPW		0,1	0,1	0,1
Steam credit		- 6,0	- 6,0	- 6,0
b./ Total utilities	\$/t	- 3,3	- 3,3	- 3,3
c./ Labour	\$/t	1,6	1,0	0,3
d./ Overhead expenses	\$/t	2,4	1,5	0,5
e./ Total/a+b+c+d/	\$/t	2,4	0,9	- 0,8
f./ Depreciation	\$/t	15,8	15,7	15,8
g./ Maintenance	\$/t	4,7	4,7	4,7
h./ Insurance and property taxes	\$/t	3,2	3,2	3,2
i./ Total /f+g+h/	\$/t	23,7	23,6	23,7
j./ Total production cost / e+i/	\$/t	26,1	24,5	22,9
k./ 15% R.O.I.	\$/t	23,7	23,7	23,7
l./ Total /j+k/	\$/t	49,8	48,2	46,6
m./ Feedstock costs				
/ NH ₃ /	1. \$/t	75,6	55,9	48,7
	2. \$/t	80,6	61,5	53,5
	3. \$/t	93,0	75,4	65,4
	4. \$/t	105,2	89,0	77,1
n./ Product value /l+m/ at factory gate				
	1. \$/t	125,4	104,1	95,3
	2. \$/t	130,4	109,7	100,1
	3. \$/t	142,8	123,6	112,0
	4. \$/t	155,0	137,2	123,7
o./ Distribution cost	\$/t	-	-	-
p./ Farm-gate price /n+o/	\$/t	-	-	-
	\$/t	-	-	-
	\$/t	-	-	-
	\$/t	-	-	-

Product: Ammonium nitrateRaw material: natural gasLocation: Developed site, West-Europe

Capacity	t/d	355	591	2364
On-stream factor	%	90	90	90
Production	kt/y	117	195	780
Total investment cost	M£	10,9	16,2	48,7

Production cost

<u>Materials</u>	£/t			
lime		0,8	0,8	0,8
coating agent		0,6	0,6	0,6
anti-coating agent		1,0	1,0	1,0
MgO		0,8	0,8	0,8
a./ Total materials	£/t	3,2	3,2	3,2
<u>Utilities</u>	£/t			
Power		0,7	0,7	0,7
Steam	"	3,6	3,6	3,6
BFW/demineralized/ Cooling water	"	0,8	0,8	0,8

b./ Total utilities	£/t	5,1	5,1	5,1
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c./ Labour	£/t	2,1	1,2	0,3
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d./ Overhead expenses	£/t	3,2	3,0	0,5
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e./ Total/a+b+c+d/	£/t	13,6	12,5	9,1
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f./ Depreciation	£/t	9,3	8,3	6,2
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g./ Maintenance	£/t	2,3	2,5	1,9
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h./ Insurance and property taxes	£/t	1,9	1,7	1,2
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i./ Total /f+g+h/	£/t	14,0	12,5	9,3
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j./ Total production cost / e+i/	£/t	27,6	25,0	18,4
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k./ 15% R.O.I.	£/t	14,0	12,0	9,3
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l./ Total /j+k/	£/t	41,6	37,5	27,7
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m./ Feedstock costs		NH ₃	HNO ₃	NH ₃	HNO ₃	NH ₃	HNO ₃
1.	\$/t	55,4	96,3	40,9	79,9	35,6	73,2
2.	\$/t	59,0	100,1	45,0	84,2	39,2	76,9
3.	\$/t	68,1	109,7	55,2	94,9	47,9	86,0
4.	\$/t	77,0	119,0	65,2	105,4	56,5	95,0

n./ Product value /l+m/ at factory gate						
1. £/t		193,3		158,3		136,5
2. £/t		200,7		166,7		143,8
3. £/t		219,4		187,6		161,6
4. £/t		237,6		208,1		179,2

o./ Distribution cost	£/t	-	-	-
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p./ Farm-gate price /n+o/	£/t	-	-	-
	£/t			
	£/t			
	£/t			

Product: Ammonia

Raw material: natural gas

Location: Developing site, Seaside

Capacity	t/d	150	250	1000
On-stream factor	%	90	90	75
Production	kt/y	50	83	275
Total investment cost	M\$	37	49,6	213,5
<u>Production cost</u>				
Materials	\$/t			
Chemicals		8,0	8,0	8,0

a./ Total materials	\$/t	8,0	8,0	8,0
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Utilities	\$/t			
Power	"	26,5	-	2,2
Steam	"	-	-	-
BP./demineralized/	"	0,9	0,6	0,6
Cooling water	"	10,3	6,0	2,4

b./ Total utilities	\$/t	37,7	6,6	5,2
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c./ Labour	\$/t	5,1	3,1	0,9
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d./ Overhead expenses	\$/t	12,8	7,8	2,3
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e./ Total/a+b+c+d/	\$/t	63,6	25,5	16,4
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f./ Depreciation	\$/t	74,0	59,8	77,6
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g./ Maintenance	\$/t	29,6	23,9	31,0
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h./ Insurance and property taxes	\$/t	22,2	17,9	23,3
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i./ Total /f+g+h/	\$/t	125,8	101,6	131,9
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j./ Total production cost / e+i/	\$/t	189,4	127,1	148,3
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k./ 15% R.O.I.	\$/t	111,0	89,7	116,4
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l./ Total /j+k/	\$/t	300,4	216,8	264,7
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m./ Feedstock costs				
1. 8 \$ 106 kcal 1. \$/t		13,5	15,1	13,0
/natural 3,5 \$ "	2. \$/t	26,3	29,4	25,2
gas/ 5,9 \$ "	3. \$/t	44,2	49,6	42,5
8500 11,8 \$ "	4. \$/t	88,5	99,1	85,0
kcal/kg/				

n./ Product value /l+m/ at factory gate	1. \$/t	313,5	231,9	277,7
	2. \$/t	326,7	246,2	289,9
	3. \$/t	344,6	266,4	307,2
	4. \$/t	388,9	315,9	349,7

o./ Distribution cost	\$/t	-	-	-
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p./ Farm-gate price /n+o/	\$/t	-	-	-
	\$/t	-	-	-
	\$/t	-	-	-
	\$/t	-	-	-

Product: Urea

Raw material: natural gas

Location: Developing site, Seaside

Capacity	t/d	260	440	1700
On-stream factor	%	90	90	75
Production	kt/y	86	145	468
Total investment cost	M\$	20,0	30,0	102,5
<u>Production cost</u>				
<u>Materials</u>	\$/t			
CO ₂		-	-	-
a./ Total materials	\$/t	-	-	-
<u>Utilities</u>				
Power	"	4,5	4,2	3,9
Steam	"	13,8	13,5	12,6
BP./demineralized/ Cooling water	"	1,4	1,4	1,2
Steam credit	"	-	-	- 0,8
b./ Total utilities	\$/t	19,7	19,1	16,9
c./ Labour	\$/t	1,9	1,1	0,3
d./ Overhead expenses	\$/t	4,8	2,8	0,8
e./ Total/a+b+c+d/	\$/t	26,4	23,0	18,0
f./ Depreciation	\$/t	23,3	20,9	21,9
g./ Maintenance	\$/t	9,3	8,4	8,8
h./ Insurance and property taxes	\$/t	7,0	6,3	6,6
i./ Total /f+g+h/	\$/t	39,6	35,6	37,3
j./ Total production cost / e+i/	\$/t	66,0	58,6	55,3
k./ 15% R.O.I.	\$/t	35,0	31,4	32,9
l./ Total /j+k/	\$/t	101,0	90,0	88,2
<u>m./ Feedstock costs</u>				
/NH ₃ /	1. \$/t	178,7	132,2	158,5
	2. \$/t	186,2	140,3	165,5
	3. \$/t	196,4	151,9	175,3
	4. \$/t	221,6	180,1	199,3
<u>n./ Product value /l+m/ at factory gate</u>				
	1. \$/t	279,7	222,2	246,7
	2. \$/t	287,2	230,3	253,7
	3. \$/t	297,4	241,9	263,5
	4. \$/t	322,6	270,1	287,5
o./ Distribution cost	\$/t	15,0	15,0	60,0
<u>p./ Farm-gate price /n+o/</u>				
	1. \$/t	294,7	237,2	306,7
	2. \$/t	302,2	245,3	313,7
	3. \$/t	312,4	256,9	323,5
	4. \$/t	337,6	285,1	347,5

Product: Nitric acidRaw material: natural gasLocation: Developing site, Seaside

Capacity	t/d	273	455	1822
On-stream factor	%	90	90	95
<u>Production</u>	kt/y	90	150	500
Total investment cost	M\$	18,0	30,0	139,5
<u>Production cost</u>				
<u>Materials</u>	\$/t	1,7	1,7	1,7

a./ Total materials	\$/t	1,7	1,7	1,7
<u>Utilities</u>	\$/t			
Power	"	0,4	0,4	0,4
Steam	"	-	-	-
BFW/demineralized/	"	-	-	-
Cooling water	"	2,2	2,2	2,2
BFW		0,1	0,1	0,1
Steam credit		- 6,0	- 6,0	- 6,0
b./ Total utilities	\$/t	- 3,3	- 3,3	- 3,3
c./ Labour	\$/t	0,9	0,5	0,2
d./ Overhead expenses	\$/t	2,3	1,3	0,5
e./ Total/a+b+c+d/	\$/t	1,6	0,2	- 0,9
f./ Depreciation	\$/t	20,0	20,0	27,9
g./ Maintenance	\$/t	8,0	8,0	11,2
h./ Insurance and property taxes	\$/t	6,0	6,0	8,4
i./ Total /f+g+h/	\$/t	34,0	34,0	47,5
j./ Total production cost / e+i/	\$/t	35,6	34,2	46,6
k./ 15% R.O.I.	\$/t	30,0	30,0	41,9
l./ Total /j+k/	\$/t	65,6	64,2	88,5
m./ Feedstock costs				
1. \$/t		87,8	65,0	77,9
2. \$/t		91,5	68,9	81,3
3. \$/t		96,5	74,6	86,1
4. \$/t		108,9	88,5	98,0
/NH ₃ /				
n./ Product value /l+m/ at factory gate				
1. \$/t		153,4	129,2	166,4
2. \$/t		157,1	133,1	169,8
3. \$/t		162,1	138,8	174,6
4. \$/t		174,5	152,7	186,5
o./ Distribution cost	\$/t	-	-	-
p./ Farm-gate price /n+o/	\$/t	-	-	-
	\$/t			
	\$/t			
	\$/t			

Product: Ammonium nitrateRaw material: natural gasLocation: Developing site, Sesside

Capacity	t/d	355	591	2364
On-stream factor	%	90	90	75
<u>Production</u>	kt/y	117	195	650

Total investment cost	M\$	13,9	20,5	71,8
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Production cost

<u>Materials</u>	\$/t			
lime		0,8	0,8	0,8
coating agent		0,6	0,6	0,6
anti-coating agent		1,0	1,0	1,0
MgO		0,8	0,8	0,8

a./ Total materials	\$/t	3,2	3,2	3,2
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<u>Utilities</u>	\$/t			
Power	"	0,7	0,7	0,7
Steam	"	3,6	3,6	3,6
BFW/demineralized/ Cooling water	"	-	-	-
		0,8	0,8	0,8

b./ Total utilities	\$/t	5,1	5,1	5,1
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c./ Labour	\$/t	1,1	0,7	0,2
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d./ Overhead expenses	\$/t	2,8	1,8	0,8
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e./ Total/a+b+c+d/	\$/t	12,2	10,8	9,3
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f./ Depreciation	\$/t	11,9	10,5	11,0
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g./ Maintenance	\$/t	4,8	4,2	4,4
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h./ Insurance and property taxes	\$/t	3,6	3,2	3,3
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i./ Total /f+g+h/	\$/t	20,3	17,9	18,7
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j./ Total production cost / e+i/	\$/t	32,5	28,7	28,0
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k./ 15% R.O.I.	\$/t	17,9	15,8	16,5
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l./ Total /j+k/	\$/t	50,4	44,5	44,5
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m./ Feedstock costs		NH ₃	HNO ₃	NH ₃	HNO ₃	NH ₃	HNO ₃
1. \$/t		64,3	117,8	47,5	99,2	57,0	127,8
2. \$/t		67,0	120,7	50,5	102,2	59,5	130,4
3. \$/t		70,6	124,5	54,6	106,6	63,1	134,1
4. \$/t		79,7	134,0	64,8	117,3	71,8	143,2

n./ Product value /l+m/ at factory gate							
1. \$/t		232,5		191,2		229,3	
2. \$/t		238,1		197,2		234,4	
3. \$/t		245,5		205,7		241,7	
4. \$/t		264,1		226,6		259,5	

o./ Distribution cost	\$/t	15,0	15,0	60,0
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p./ Farm-gate price /n+o/	\$/t	247,5	206,2	289,3
	\$/t	253,1	212,2	294,4
	\$/t	260,5	220,7	301,7
	\$/t	279,1	241,6	319,5

<u>Product:</u> Ammonia				
<u>Raw material:</u> natural gas				
<u>Location:</u> Developing site, Remote				
Capacity	t/d	150	250	1000
On-stream factor	%	90	90	75
<u>Production</u>	kt/y	50	83	275
Total investment cost	M\$	43,0	58,0	277,4
<u>Production cost</u>				
<u>Materials</u>	\$/t			
Chemicals		8,0	8,0	8,0
a./ Total materials	\$/t	8,0	8,0	8,0
<u>Utilities</u>				
	\$/t			
Power	"	26,5	-	2,2
Steam	"	-	-	-
BP./demineralized/	"	0,9	0,6	0,6
Cooling water	"	10,3	6,0	2,4
b./ Total utilities	\$/t	37,7	6,6	5,2
c./ Labour	\$/t	5,1	3,1	0,9
d./ Overhead expenses	\$/t	12,8	7,8	2,3
e./ Total/a+b+c+d/	\$/t	63,6	25,5	16,4
f./ Depreciation	\$/t	86,0	69,9	100,9
g./ Maintenance	\$/t	34,4	28,0	40,4
h./ Insurance and property taxes	\$/t	25,8	21,0	30,3
i./ Total /f+g+h/	\$/t	146,2	118,9	171,6
j./ Total production cost / e+i/	\$/t	209,8	144,4	188,0
k./ 15% R.O.I.	\$/t	129,0	104,9	151,4
l./ Total /j+k/	\$/t	338,8	249,3	339,4
<u>m./ Feedstock costs</u>				
1,8 \$ 10 ⁶ kcal	1. \$/t	13,5	15,1	13,0
/natural 3,5 \$ "	2. \$/t	26,3	29,4	25,2
gas 5,9 \$ "	3. \$/t	44,2	49,6	42,5
8500 kcal/11,8 \$ "	4. \$/t	88,5	99,1	85,0
/kg				
<u>n./ Product value /l+m/</u>				
at factory gate				
1. \$/t		352,2	264,4	352,4
2. \$/t		365,1	278,7	364,6
3. \$/t		383,0	298,9	381,9
4. \$/t		427,3	348,4	424,4
o./ Distribution cost	\$/t	-	-	-
<u>p./ Farm-gate price /n+o/</u>				
	\$/t	-	-	-
	\$/t			
	\$/t			
	\$/t			

Product: Urea

Raw material: natural gas

Location: Developing site, Remote

Capacity	t/d	260	440	1700
On-stream factor	%	90	90	75
Production	kt/y	86	145	468
Total investment cost	MM	23,4	35,5	133,2
Production cost				
Materials	\$/t	-	-	-
CO ₂				

a./ Total materials	\$/t	-	-	-
Utilities	\$/t			
Power	"	4,5	4,2	3,9
Steam	"	13,8	13,5	12,6
BP./demineralized/	"	-	-	-
Cooling water	"	1,4	1,4	1,2
Steam credit	"	-	-	- 0,8
b./ Total utilities	\$/t	19,7	19,1	16,9
c./ Labour	\$/t	1,9	1,1	0,3
d./ Overhead expenses	\$/t	4,8	2,8	0,8
e./ Total/a+b+c+d/	\$/t	26,4	23,0	18,0
f./ Depreciation	\$/t	27,2	24,5	28,5
g./ Maintenance	\$/t	10,9	9,8	11,4
h./ Insurance and property taxes	\$/t	8,2	7,4	8,6
i./ Total /f+g+h/	\$/t	46,3	41,7	48,5
j./ Total production cost / e+i/	\$/t	72,7	64,7	66,5
k./ 15% R.O.I.	\$/t	40,8	36,8	42,8
l./ Total /j+k/	\$/t	113,5	101,5	109,3
m./ Feedstock costs /NH ₃ /				
1.	\$/t	200,8	150,7	201,0
2.	\$/t	208,1	158,9	208,1
3.	\$/t	218,3	170,4	217,9
4.	\$/t	243,6	198,6	242,1
n./ Product value /l+m/ at factory gate				
1.	\$/t	314,3	252,2	310,3
2.	\$/t	321,6	260,4	317,4
3.	\$/t	331,8	271,9	327,2
4.	\$/t	357,1	300,1	351,4
o./ Distribution cost	\$/t	15,0	15,0	60,0
p./ Farm-gate price /n+o/				
1.	\$/t	329,3	267,2	370,3
2.	\$/t	336,6	275,4	377,4
3.	\$/t	346,8	286,9	387,2
4.	\$/t	372,1	315,1	411,4

Product: Nitric acidRaw material: natural gasLocation: Developing site, Remote

Capacity	t/d	273	455	1822
On-stream factor	%	90	90	75
Production	kt/y	90	150	500
Total investment cost	M\$	21,3	35,1	181,2
Production cost				
Materials	\$/t			
Platina		1,7	1,7	1,7
a./ Total materials	\$/t	1,7	1,7	1,7
Utilities	\$/t			
Power	"	0,4	0,4	0,4
Steam	"	-	-	-
BFW/demineralized/	"	-	-	-
Cooling water	"	2,2	2,2	2,2
BFW		0,1	0,1	0,1
Steam credit		- 6,0	- 6,0	- 6,0
b./ Total utilities	\$/t	- 3,3	- 3,3	- 3,3
c./ Labour	\$/t	0,9	0,5	0,2
d./ Overhead expenses	\$/t	2,3	1,3	0,5
e./ Total/a+b+c+d/	\$/t	1,6	0,2	- 0,9
f./ Depreciation	\$/t	23,7	23,4	36,2
g./ Maintenance	\$/t	9,5	9,4	14,5
h./ Insurance and property taxes	\$/t	7,1	7,0	10,9
i./ Total /f+g+h/	\$/t	40,3	39,8	61,6
j./ Total production cost / e+i/	\$/t	41,9	40,0	60,7
k./ 15% R.O.I.	\$/t	35,6	35,1	54,3
l./ Total /j+k/	\$/t	77,5	75,1	115,0
m./ Feedstock costs				
/NH ₃ /	1. \$/t	98,6	74,0	98,8
	2. \$/t	102,2	78,0	102,2
	3. \$/t	107,2	83,7	107,0
	4. \$/t	119,6	97,6	118,9
n./ Product value /l+m/ at factory gate				
	1. \$/t	176,1	149,1	213,8
	2. \$/t	179,7	153,1	217,2
	3. \$/t	184,7	158,8	222,0
	4. \$/t	197,1	172,7	233,9
o./ Distribution cost	\$/t	-	-	-
p./ Farm-gate price /n+o/	\$/t	-	-	-
	\$/t			
	\$/t			
	\$/t			

Product: Ammonium nitrate

Raw material: natural gas

Location: Developing site, Remote

Capacity	t/d	355	591	2364
On-stream factor	%	90	90	75
Production	kt/y	117	195	650
Total investment cost	M\$	16,2	24,1	93,2
Production cost				
Materials	\$/t			
lime		0,8	0,8	0,8
coating agent		0,6	0,6	0,6
anti-coating agent		1,0	1,0	1,0
MgO		0,8	0,8	0,8
a./ Total materials	\$/t	3,2	3,2	3,2
Utilities	\$/t			
Power	"	0,7	0,7	0,7
Steam	"	3,6	3,6	3,6
BFW/demineralized/ Cooling water	"	0,3	0,8	0,8
b./ Total utilities	\$/t	5,1	5,1	5,1
c./ Labour	\$/t	1,1	0,7	0,2
d./ Overhead expenses	\$/t	2,8	1,8	0,8
e./ Total/a+b+c+d/	\$/t	12,2	10,8	9,3
f./ Depreciation	\$/t	13,8	12,4	14,3
g./ Maintenance	\$/t	5,5	5,0	5,7
h./ Insurance and property taxes	\$/t	4,1	3,7	4,3
i./ Total /f+g+h/	\$/t	23,4	21,1	24,3
j./ Total production cost / e+i/	\$/t	35,6	31,9	33,6
k./ 15% R.O.I.	\$/t	20,7	18,6	21,5
l./ Total /j+k/	\$/t	56,3	50,5	55,1
m./ Feedstock costs				
1.	\$/t	NH ₃ 72,2	HNO ₃ 114,5	NH ₃ 72,3
2.	\$/t	135,2	54,2	72,3
3.	\$/t	74,8	138,0	57,2
4.	\$/t	78,5	141,8	61,3
	\$/t	87,6	151,4	71,4
	\$/t		132,6	87,1
	\$/t			164,2
	\$/t			166,8
	\$/t			170,5
	\$/t			179,6
n./ Product value /l+m/ at factory gate				
1.	\$/t	263,7	219,2	291,6
2.	\$/t	269,1	225,3	296,7
3.	\$/t	276,6	233,8	304,0
4.	\$/t	295,3	254,5	321,8
o./ Distribution cost	\$/t	15,0	15,0	60,0
p./ Farm-gate price /n+o/				
1.	\$/t	278,7	234,2	351,6
2.	\$/t	284,1	240,3	356,7
3.	\$/t	291,6	248,8	364,0
4.	\$/t	310,3	269,5	381,8

Product: AmmoniaRaw material: fuel oilLocation: Developed site, West-Europe

Capacity	t/d	150	250	1000
On-stream factor	%	90	90	90
<u>Production</u>	kt/y	50	83	330
Total investment cost	M\$	33,0	45,0	167,0
<u>Production cost</u>				
<u>Materials</u>	\$/t	8,0	8,0	8,0
Chemicals				
a./ Total materials	\$/t	8,0	8,0	8,0
<u>Utilities</u>	\$/t			
Power	"	27,0	-	2,4
Steam	"	-	-	-
BP./demineralized/	"	1,0	1,0	1,0
Cooling water	"	11,0	6,4	3,2
b./ Total utilities	\$/t	39,0	7,4	6,6
c./ Labour	\$/t	12,0	7,2	1,8
d./ Overhead expenses	\$/t	18,0	10,8	2,7
e./ Total/a+b+c+d/	\$/t	77,0	33,4	19,1
f./ Depreciation	\$/t	66,0	54,2	50,6
g./ Maintenance	\$/t	19,8	16,3	15,2
h./ Insurance and property taxes	\$/t	13,2	10,8	10,1
i./ Total /f+g+h/	\$/t	99,0	81,3	75,9
j./ Total production cost / e+i/	\$/t	176,0	114,7	95,0
k./ 15% R.O.I.	\$/t	99,0	81,3	75,9
l./ Total /j.k/	\$/t	275,0	196,0	170,9
m./ Feedstock costs				
/Fuel 15 \$/10 ⁶ kcal 1.	\$/t	117,0	130,5	123,6
oil/ 18 \$/10 ⁶ kcal 2.	\$/t	140,4	156,6	148,3
	\$/t			
n./ Product value /l+m/ at factory gate 1.	\$/t	392,0	326,5	394,5
2.	\$/t	415,4	352,6	319,2
	\$/t			
o./ Distribution cost	\$/t	-	-	-
p./ Farm-gate price /n+o/	\$/t	-	-	-
	\$/t			
	\$/t			
	\$/t			

Product: Urea

Raw material: fuel oil

Location: Developed site, West-Europe

Capacity	t/d	260	440	1700
On-stream factor	%	90	90	90
Production	kt/y	86	145	560
Total investment cost	M£	15,7	23,8	69,6
<u>Production cost</u>				
<u>Materials</u>	£/t			
CO ₂		-	-	-
a./ Total materials	£/t	-	-	-
<u>Utilities</u>				
	£/t			
Power	"	4,5	4,2	3,9
Steam	"	13,8	13,5	12,6
BP./demineralized/	"	-	-	-
Cooling water	"	1,4	1,4	1,2
Steam credit	"	-	-	- 0,8
b./ Total utilities	£/t	19,7	19,1	16,9
c./ Labour	£/t	3,5	2,1	0,5
d./ Overhead expenses	£/t	5,3	3,2	0,8
e./ Total/a+b+c+d/	£/t	28,5	24,4	18,2
f./ Depreciation	£/t	18,3	16,4	12,4
g./ Maintenance	£/t	5,5	4,9	3,7
h./ Insurance and property taxes	£/t	3,7	3,3	2,5
i./ Total /f+g+h/	£/t	27,5	24,6	18,6
j./ Total production cost / e+i/	£/t	56,0	49,0	36,8
k./ 15% R.O.I.	£/t	27,5	24,6	18,6
l./ Total /j+k/	£/t	83,5	73,6	55,4
m./ Feedstock costs /NH ₃ /	1. £/t	223,4	186,1	167,8
	2. £/t	236,8	201,0	181,9
	£/t			
n./ Product value /l+m/ at factory gate	1. £/t	306,9	259,7	223,2
	2. £/t	320,3	274,6	237,3
	£/t			
	£/t			
o./ Distribution cost	£/t	-	-	-
p./ Farm-gate price /n+o/	£/t	-	-	-
	£/t			
	£/t			
	£/t			

Product: Nitric acidRaw material: fuel oilLocation: Developed site, West-Europe

Capacity	t/d	273	455	1922
On-stream factor	%	90	90	90
<u>Production</u>	kt/y	90	150	600
Total investment cost	M\$	14,2	23,6	94,7
<u>Production cost</u>				
<u>Materials</u>	\$/t	1,7	1,7	1,7

a./ Total materials	\$/t	1,7	1,7	1,7
<u>Utilities</u>	\$/t			
Power	"	0,4	0,4	0,4
Steam	"	-	-	-
BPW/demineralized/	"	-	-	-
Cooling water	"	2,2	2,2	2,2
BPW		0,1	0,1	0,1
Steam credit		- 6,0	- 6,0	- 6,0
b./ Total utilities	\$/t	- 3,3	- 3,3	- 3,3
c./ Labour	\$/t	1,6	1,0	0,3
d./ Overhead expenses	\$/t	2,4	1,5	0,5
e./ Total/a+b+c+d/	\$/t	2,4	0,9	- 0,8
f./ Depreciation	\$/t	15,8	15,7	15,8
g./ Maintenance	\$/t	4,7	4,7	4,7
h./ Insurance and property taxes	\$/t	3,2	3,2	3,2
i./ Total /f+g+h/	\$/t	23,7	23,6	23,7
j./ Total production cost / e+i/	\$/t	26,1	24,5	22,9
k./ 15% R.O.I.	\$/t	23,7	23,7	23,7
l./ Total /j+k/	\$/t	49,8	48,2	46,6
m./ Feedstock costs /NH ₃ /				
1.	\$/t	109,8	91,4	82,4
2.	\$/t	116,3	98,7	39,3
	\$/t			
n./ Product value /l+m/ at factory gate				
1.	\$/t	159,6	139,6	129,0
2.	\$/t	166,1	146,9	135,9
	\$/t			
o./ Distribution cost	\$/t	-	-	-
p./ Farm-gate price /n+o/				
	\$/t	-	-	-
	\$/t			
	\$/t			
	\$/t			

Product: Ammonium nitrateRaw material: fuel oilLocation: Developed site, West-Europe

Capacity	t/d	355	591	2364
On-stream factor	%	90	90	90
Production	kt/y	117	195	780

Total investment cost	M£	10,9	16,2	48,7
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Production cost

<u>Materials</u>	£/t			
lime		0,8	0,8	0,8
coating agent		0,6	0,6	0,6
anti-coating agent		1,0	1,0	1,0
MgO		0,8	0,8	0,8

a./ Total materials	£/t	3,2	3,2	3,2
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<u>Utilities</u>	£/t			
Power	"	0,7	0,7	0,7
Steam	"	3,6	3,6	3,6
BPW/demineralized/	"	-	-	-
Cooling water	"	0,8	0,8	0,8

b./ Total utilities	£/t	5,1	5,1	5,1
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c./ Labour	£/t	2,1	1,2	0,3
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d./ Overhead expenses	£/t	3,2	3,0	0,5
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e./ Total/a+b+c+d/	£/t	13,6	12,5	9,1
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f./ Depreciation	£/t	9,3	8,3	6,2
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g./ Maintenance	£/t	2,8	2,5	1,9
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h./ Insurance and property taxes	£/t	1,9	1,7	1,2
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i./ Total /f+g+h/	£/t	14,0	12,5	9,3
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j./ Total production cost / e+i/	£/t	27,6	25,0	18,4
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k./ 15% R.O.I.	£/t	14,0	12,5	9,3
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l./ Total /j+k/	£/t	41,6	37,5	27,7
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m./ Feedstock costs							
1.	£/t	NH ₃	HNO ₃	NH ₃	HNO ₃	NH ₃	HNO ₃
2.	£/t	80,4	122,6	66,9	107,2	60,3	99,1
	£/t	85,2	127,6	72,2	112,8	65,4	104,4
	£/t						

n./ Product value /l+m/ at factory gate	1.	£/t	244,6	211,6	187,1
	2.	£/t	254,4	222,5	197,5
		£/t			
		£/t			

o./ Distribution cost	£/t	-	-	-
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p./ Farm-gate price /n+o/	£/t	-	-	-
	£/t			
	£/t			
	£/t			

Product: AmmoniaRaw material: fuel oilLocation: Developing site, Seaside

Capacity	t/d	150	250	1000
On-stream factor	%	90	90	75
<u>Production</u>	kt/y	50	83	275
Total investment cost	M\$	42,0	57,0	246,0
<u>Production cost</u>				
<u>Materials</u>	\$/t			
Chemicals	"	8,0	8,0	8,0
a./ Total materials	\$/t	8,0	8,0	8,0
<u>Utilities</u>	\$/t			
Power	"	27,0	-	2,4
Steam	"	-	-	-
BP./demineralized/	"	1,0	1,0	1,0
Cooling water	"	11,0	6,4	3,2
b./ Total utilities	\$/t	39,0	7,4	6,6
c./ Labour	\$/t	6,4	3,9	1,2
d./ Overhead expenses	\$/t	16,0	9,8	3,0
e./ Total/a+b+c+d/	\$/t	69,4	29,1	18,8
f./ Depreciation	\$/t	84,0	68,7	89,5
g./ Maintenance	\$/t	33,6	27,5	35,8
h./ Insurance and property taxes	\$/t	25,2	20,6	26,9
i./ Total /f+g+h/	\$/t	142,8	116,8	152,2
j./ Total production cost / e+i/	\$/t	212,2	145,9	171,0
k./ 15% R.O.I.	\$/t	126,0	103,1	134,3
l./ Total /j+k/	\$/t	338,2	249,0	305,3
m./ Feedstock costs				
/fuel 12 \$/10 ⁶ kcal	1. \$/t	93,6	104,4	98,9
oil/ 15 " "	2. \$/t	117,0	130,5	123,6
	\$/t			
n./ Product value /l+m/ at factory gate	1. \$/t	431,8	353,4	404,2
	2. \$/t	455,2	379,5	428,9
	\$/t			
o./ Distribution cost	\$/t	-	-	-
p./ Farm-gate price /n+o/	\$/t	-	-	-
	\$/t			
	\$/t			
	\$/t			

Product: Urea

Raw material: fuel oil

Location: Developing site, Seaside

Capacity	t/d	260	440	1700
On-stream factor	%	90	90	75
Production	kt/y	86	145	468
Total investment cost	M\$	20,0	30,3	102,5
<u>Production cost</u>				
<u>Materials</u>	\$/t			
CO ₂		-	-	-
a./ Total materials	\$/t	-	-	-
<u>Utilities</u>				
Power	"	4,5	4,2	3,9
Steam	"	13,8	13,5	12,6
BFW/demineralized/ Cooling water	"	1,4	1,4	1,2
Steam credit	"	-	-	- 0,8
b./ Total utilities	\$/t	19,7	19,1	16,9
c./ Labour	\$/t	1,9	1,1	0,3
d./ Overhead expenses	\$/t	4,8	2,8	0,8
e./ Total/a+b+c+d/	\$/t	26,4	23,0	18,0
f./ Depreciation	\$/t	23,3	20,9	21,9
g./ Maintenance	\$/t	9,3	8,4	8,8
h./ Insurance and property taxes	\$/t	7,0	6,3	6,6
i./ Total /f+g+h/	\$/t	39,6	35,6	37,3
j./ Total production cost / e+i/	\$/t	66,0	58,6	55,3
k./ 15% R.O.I.	\$/t	35,0	31,4	32,9
l./ Total /j+k/	\$/t	101,0	90,0	88,2
m./ Feedstock costs				
/NH ₃ /	1. \$/t	246,1	201,4	230,4
	2. \$/t	259,5	216,3	244,5
	\$/t			
	\$/t			
n./ Product value /l+m/ at factory gate	1. \$/t	347,1	291,4	318,6
	2. \$/t	360,5	306,3	332,7
	\$/t			
	\$/t			
o./ Distribution cost	\$/t	15,0	15,0	60,0
p./ Farm-gate price /n+o/	1. \$/t	362,1	306,4	378,6
	2. \$/t	375,5	321,3	392,7
	\$/t			
	\$/t			

Product: Nitric acidRaw material: fuel oilLocation: Developing site, Seaside

Capacity	t/d	273	255	1822
On-stream factor	%	90	90	75
<u>Production</u>	kt/y	90	150	500
Total investment cost	M\$	18,0	30,0	139,5
<u>Production cost</u>				

<u>Materials</u>	\$/t			
Platins		1,7	1,7	1,7

a./ Total materials	\$/t	1,7	1,7	1,7
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<u>Utilities</u>	\$/t			
Power	"	0,4	0,4	0,4
Steam	"	-	-	-
BFW/demineralized/	"	-	-	-
Cooling water	"	2,2	2,2	2,2
BFW		0,1	0,1	0,1
Steam credit		- 6,0	- 6,0	- 6,0

b./ Total utilities	\$/t	- 3,3	- 3,3	- 3,3
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c./ Labour	\$/t	0,9	0,5	0,2
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d./ Overhead expenses	\$/t	2,3	1,3	0,5
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e./ Total/a+b+c+d/	\$/t	1,6	0,2	- 0,9
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f./ Depreciation	\$/t	20,0	20,0	27,9
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g./ Maintenance	\$/t	8,0	8,0	11,2
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h./ Insurance and property taxes	\$/t	6,0	6,0	8,4
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i./ Total /f+g+h/	\$/t	34,0	34,0	47,5
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j./ Total production cost / e+i/	\$/t	35,6	34,2	46,6
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k./ 15% R.O.I.	\$/t	30,0	30,0	41,9
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l./ Total /j+k/	\$/t	65,6	64,2	88,5
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m./ Feedstock costs /NH ₃ /	1. \$/t	120,9	99,0	113,2
	2. \$/t	127,5	106,3	120,1
	\$/t			

n./ Product value /l+m/ at factory gate	1. \$/t	186,5	163,2	201,7
	2. \$/t	193,1	170,5	208,6
	\$/t			

o./ Distribution cost	\$/t	-	-	-
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p./ Farm-gate price /n+o/	\$/t	-	-	-
	\$/t			
	\$/t			
	\$/t			

Product: Ammonium nitrate
 Raw material: fuel oil
 Location: Developing site, Seaside

Capacity	t/d	355	591	2364
On-stream factor	%	90	90	75
Production	kt/y	117	195	650

Total investment cost	M\$	13,9	20,5	71,8
Production cost				

Materials	\$/t			
lime		0,8	0,8	0,8
coating agent		0,6	0,6	0,6
anti-caking agent		1,0	1,0	1,0
MgO		0,8	0,8	0,8

a./ Total materials	\$/t	3,2	3,2	3,2
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Utilities	\$/t			
Power	"	0,7	0,7	0,7
Steam	"	3,6	3,6	3,6
BFW/demineralized/	"	-	-	-
Cooling water	"	0,8	0,8	0,8

b./ Total utilities	\$/t	5,1	5,1	5,1
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c./ Labour	\$/t	1,1	0,7	0,2
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d./ Overhead expenses	\$/t	2,8	1,8	0,5
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e./ Total/a+b+c+d/	\$/t	12,2	10,8	9,0
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f./ Depreciation	\$/t	11,9	10,5	11,0
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g./ Maintenance	\$/t	4,8	4,2	4,4
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h./ Insurance and property taxes	\$/t	3,6	3,2	3,3
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i./ Total /f+g+h/	\$/t	20,3	17,9	18,7
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j./ Total production cost / e+i/	\$/t	32,5	28,7	27,7
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k./ 15% R.O.I.	\$/t	17,9	15,8	16,5
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l./ Total /j+k/	\$/t	50,4	44,5	44,2
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m./ Feedstock costs		NH ₃	HNO ₃	NH ₃	HNO ₃	NH ₃	HNO ₃
1.	\$/t	88,5	143,2	72,4	125,3	82,9	154,9
2.	\$/t	93,3	148,3	77,8	130,9	87,9	160,2

n./ Product value /l+m/ at factory gate				
1.	\$/t	282,1	242,2	282,0
2.	\$/t	292,0	253,2	292,3

o./ Distribution cost	\$/t	15,0	15,0	60,0
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p./ Farm-gate price /n+o/				
1.	\$/t	282,1	242,2	282,0
2.	\$/t	292,0	253,2	292,3

Product: AmmoniaRaw material: fuel oilLocation: Developing site, Remote

Capacity	t/d	150	150	1000
On-stream factor	%	90	90	75
<u>Production</u>	kt/y	50	83	275
Total investment cost	M\$	49,0	67,0	320,0
<u>Production cost</u>				
<u>Materials</u>	\$/t			
Chemicals		8,0	8,0	8,0
a./ Total materials	\$/t	8,0	8,0	8,0
<u>Utilities</u>	\$/t			
Power	"	27,0	-	2,4
Steam	"	-	-	-
BF ₃ /demineralized/	"	1,0	1,0	1,0
Cooling water	"	11,0	6,4	3,2
b./ Total utilities	\$/t	39,0	7,4	6,6
c./ Labour	\$/t	6,4	3,9	1,2
d./ Overhead expenses	\$/t	16,0	9,8	3,0
e./ Total/a+b+c+d/	\$/t	69,4	29,1	18,8
f./ Depreciation	\$/t	98,0	80,7	118,4
g./ Maintenance	\$/t	39,2	32,3	46,6
h./ Insurance and property taxes	\$/t	29,4	24,2	34,9
i./ Total /f+g+h/	\$/t	166,6	137,2	197,9
j./ Total production cost / e+i/	\$/t	236,0	166,3	216,7
k./ 15% R.O.I.	\$/t	147,0	121,0	174,6
l./ Total /j+k/	\$/t	383,0	287,3	391,3
m./ Feedstock costs				
/fuel 12 \$/10 ⁶ kcal	1. \$/t	99,6	104,4	98,9
/oil/ 15 \$ " "	2. \$/t	117,0	130,5	123,6
	\$/t			
n./ Product value /l+m/ at factory gate	1. \$/t	476,6	391,7	490,2
	2. \$/t	500,0	417,8	514,9
	\$/t			
o./ Distribution cost	\$/t	-	-	-
p./ Farm-gate price /n+o/	\$/t			
	\$/t			
	\$/t			
	\$/t			

Product: Urea

Raw material: fuel oil

Location: Developing site, Remote

Capacity	t/d	260	440	1700
On-stream factor	%	90	90	75
Production	kt/y	86	145	468
Total investment cost	M\$	23,4	35,5	133,2
Production cost				
Materials	\$/t	-	-	-
CO ₂				
a./ Total materials	\$/t	-	-	-
Utilities				
Power	"	4,5	4,2	3,9
Steam	"	13,8	13,5	12,6
BF ₃ /demineralized/	"	-	-	-
Cooling water	"	1,4	1,4	1,2
Steam credit		-	-	- 0,8
b./ Total utilities	\$/t	19,7	19,1	16,9
c./ Labour	\$/t	1,9	1,1	0,3
d./ Overhead expenses	\$/t	4,8	2,8	0,8
e./ Total/a+b+c+d/	\$/t	26,4	23,0	18,0
f./ Depreciation	\$/t	27,2	24,5	28,5
g./ Maintenance	\$/t	10,9	9,8	11,4
h./ Insurance and property taxes	\$/t	8,2	7,4	8,6
i./ Total /f+g+h/	\$/t	46,3	41,7	48,5
j./ Total production cost / e+i/	\$/t	72,7	64,7	66,5
k./ 15% R.O.I.	\$/t	40,8	36,8	42,8
l./ Total /j+k/	\$/t	113,5	101,5	109,3
m./ Feedstock costs				
/NH ₃ /	1. \$/t	271,6	223,3	279,4
	2. \$/t	285,0	238,2	293,5
	\$/t			
n./ Product value /l+m/ at factory gate				
	1. \$/t	385,1	324,8	388,7
	2. \$/t	398,5	339,7	402,8
	\$/t			
o./ Distribution cost	\$/t	15,0	15,0	60,0
p./ Farm-gate price /n+o/				
	1. \$/t	400,1	339,8	448,7
	2. \$/t	413,5	354,7	462,8
	\$/t			

<u>Product:</u> Nitric acid				
<u>Raw material:</u> fuel oil				
<u>Location:</u> Developing site, Remote				
Capacity	t/d	273	455	1822
On-stream factor	%	90	90	75
<u>Production</u>	kt/y	90	150	500
Total investment cost		M\$		
<u>Production cost</u>				
		21,3	35,1	181,2
<u>Materials</u>		\$/t		
Platinum		1,7	1,7	1,7
a./ Total materials		\$/t	1,7	1,7
<u>Utilities</u>		\$/t		
Power	"	0,4	0,4	0,4
Steam	"	-	-	-
BFW/demineralized/ Cooling water	"	2,2	2,2	2,2
BFW	"	0,1	0,1	0,1
Steam credit		- 6,0	- 6,0	- 6,0
b./ Total utilities		\$/t	- 3,3	- 3,3
c./ Labour		\$/t	0,9	0,5
d./ Overhead expenses		\$/t	2,3	1,3
e./ Total/a+b+c+d/		\$/t	1,6	0,2
f./ Depreciation		\$/t	23,7	23,4
g./ Maintenance		\$/t	9,5	9,4
h./ Insurance and property taxes		\$/t	7,1	7,0
i./ Total /f+g+h/		\$/t	40,3	39,8
j./ Total production cost / e+i/		\$/t	41,9	40,0
k./ 15% R.O.I.		\$/t	35,6	35,1
l./ Total /j+k/		\$/t	77,5	75,1
m./ Feedstock costs				
/NH ₃ /	1. \$/t	133,4	109,7	137,2
	2. \$/t	140,0	117,0	144,2
n./ Product value /l+m/ at factory gate				
	1. \$/t	210,9	184,8	252,3
	2. \$/t	217,5	192,1	259,2
o./ Distribution cost		\$/t	-	-
p./ Farm-gate price /n+o/		\$/t	-	-
		\$/t	-	-
		\$/t	-	-

Product: Ammonium nitrate

Raw material: fuel oil

Location: Developing site, Remote

Capacity	t/d	355	591	2364
On-stream factor	%	90	90	75
Production	kt/y	117	195	650

Total investment cost	M\$	16,2	24,1	93,2
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Production cost

<u>Materials</u>	\$/t			
lime		0,8	0,8	0,8
coating agent		0,6	0,6	0,6
anti-coating agent		1,0	1,0	1,0
MgO		0,8	0,8	0,8

a./ Total materials	\$/t	3,2	3,2	3,2
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<u>Utilities</u>	\$/t			
Power	"	0,7	0,7	0,7
Steam	"	3,6	3,6	3,6
BFW/demineralized/ Cooling water	"	0,8	0,8	0,8

b./ Total utilities	\$/t	5,1	5,1	5,1
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c./ Labour	\$/t	1,1	0,7	0,2
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d./ Overhead expenses	\$/t	2,8	1,8	0,5
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e./ Total/a+b+c+d/	\$/t	12,2	10,8	9,0
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f./ Depreciation	\$/t	13,8	12,4	14,3
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g./ Maintenance	\$/t	5,5	5,0	5,7
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h./ Insurance and property taxes	\$/t	4,1	3,7	4,3
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i./ Total /f+g+h/	\$/t	23,4	21,1	24,3
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j./ Total production cost / e+i/	\$/t	35,6	31,9	33,3
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k./ 15% R.O.I.	\$/t	20,7	18,6	21,5
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l./ Total /j+k/	\$/t	56,3	50,5	54,8
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m./ Feedstock costs			NH ₃	HNO ₃	NH ₃	HNO ₃	NH ₃	HNO ₃
1.	\$/t		97,7	162,0	80,3	141,8	100,5	193,8
2.	\$/t		102,5	167,0	85,6	147,5	105,6	199,1
	\$/t							

n./ Product value /l+m/ at factory gate					
1.	\$/t		375,6	321,1	382,7
2.	\$/t		385,5	332,0	393,2
	\$/t				

o./ Distribution cost	\$/t	15,0	15,0	60,0
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p./ Farm-gate price /n+o/				
1.	\$/t		316,0	272,6
2.	\$/t		325,8	283,6
	\$/t			

Product: Ammonia

Raw material: coal

Location: Developed site, West-Europe

Capacity	t/d	150	250	1000
On-stream factor	%	90	90	90
Production	kt/y	50	83	330
Total investment cost	M\$	46,0	62,0	232,0
Production cost				
Materials	\$/t			
Chemicals		8,0	8,0	8,0

a./ Total materials	\$/t	8,0	8,0	8,0
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Utilities	\$/t			
Power	"	33,0	-	3,0
Steam	"	-	-	-
BPW/demineralized/ Cooling water	"	1,8 16,0	1,5 6,9	1,5 3,4

b./ Total utilities	\$/t	50,8	8,4	7,9
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c./ Labour	\$/t	18,0	10,8	2,9
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d./ Overhead expenses	\$/t	27,0	16,2	4,4
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e./ Total/a+b+c+d/	\$/t	103,8	43,4	23,2
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f./ Depreciation	\$/t	92,0	74,7	70,3
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g./ Maintenance	\$/t	27,6	22,4	21,1
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h./ Insurance and property taxes	\$/t	18,4	15,0	14,1
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i./ Total /f+g+h/	\$/t	138,0	112,1	105,5
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j./ Total production cost / e+i/	\$/t	241,8	155,5	128,7
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k./ 15% R.O.I.	\$/t	138,0	112,1	105,5
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l./ Total /j+k/	\$/t	379,8	267,6	234,2
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m./ Feedstock costs				
/coal/ 6,8 \$/10 ⁶ kcal	1. \$/t	81,6	87,0	70,0
13,6 \$ "	2. \$/t	163,2	174,0	140,1
22,7 \$ "	3. \$/t	272,4	290,6	233,8

n./ Product value /l+m/ at factory gate	1. \$/t	461,4	354,6	304,2
	2. \$/t	543,0	441,6	374,3
	3. \$/t	652,2	558,2	468,0

o./ Distribution cost	\$/t	-	-	-
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p./ Farm-gate price /n+o/	\$/t	-	-	-
	\$/t			
	\$/t			
	\$/t			

Appendix 3/1

Product: Urea

Raw material: coal

Location: Developed site, West-Europe

Capacity	t/d	260	440	1700
On-stream factor	%	90	90	90
Production	kt/y	86	145	560
Total investment cost	M\$	15,7	23,8	69,6
Production cost				
Materials	\$/t			

a./ Total materials	\$/t			
Utilities	\$/t			
Power	"	4,5	4,2	3,9
Steam	"	13,8	13,5	12,6
BP./demineralized/ Cooling water	"	1,4	1,4	1,2
Steam credit	"	-	-	- 0,8
b./ Total utilities	\$/t	19,7	19,1	16,9
c./ Labour	\$/t	3,5	2,1	0,5
d./ Overhead expenses	\$/t	5,3	3,2	0,8
e./ Total/a+b+c+d/	\$/t	28,5	24,4	18,2
f./ Depreciation	\$/t	18,3	16,4	12,4
g./ Maintenance	\$/t	5,5	4,9	3,7
h./ Insurance and property taxes	\$/t	3,7	3,3	2,5
i./ Total /f+g+h/	\$/t	27,5	24,6	18,6
j./ Total production cost / e+i/	\$/t	56,0	49,0	36,8
k./ 15% R.O.I.	\$/t	27,5	24,6	18,6
l./ Total /j+k/	\$/t	83,5	73,6	55,4
m./ Feedstock costs				
/NH ₃ /	1. \$/t	263,0	202,1	173,4
	2. \$/t	309,5	251,7	213,4
	3. \$/t	372,0	318,2	266,8
n./ Product value /l+m/ at factory gate				
	1. \$/t	346,5	275,7	228,8
	2. \$/t	393,0	325,3	268,8
	3. \$/t	455,5	391,8	322,2
o./ Distribution cost	\$/t	-	-	-
p./ Farm-gate price /n+o/	\$/t	-	-	-
	\$/t			
	\$/t			
	\$/t			

Product: Nitric acidRaw material: coalLocation: Developed site, West-Europe

Capacity	t/d	273	455	1822
On-stream factor	%	90	90	90
<u>Production</u>	kt/y	90	130	600
Total investment cost	M\$	14,2	23,6	94,7
<u>Production cost</u>				
<u>Materials</u>	\$/t			
Platine		1,7	1,7	1,7

a./ Total materials	\$/t	1,7	1,7	1,7
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<u>Utilities</u>	\$/t			
Power	"	0,4	0,4	0,4
Steam	"	-	-	-
BPW/demineralized/ Cooling water	"	2,2	2,2	2,2
BPW		0,1	0,1	0,1
Steam credit		- 6,0	- 6,0	- 6,0

b./ Total utilities	\$/t	- 3,3	- 3,3	- 3,3
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c./ Labour	\$/t	1,6	1,0	0,3
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d./ Overhead expenses	\$/t	2,4	1,5	0,5
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e./ Total/a+b+c+d/	\$/t	2,4	0,9	- 0,8
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f./ Depreciation	\$/t	15,8	15,7	15,8
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g./ Maintenance	\$/t	4,7	4,7	4,7
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h./ Insurance and property taxes	\$/t	3,2	3,2	3,2
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i./ Total /f+g+h/	\$/t	23,7	23,6	23,7
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j./ Total production cost / e+i/	\$/t	26,1	24,5	22,9
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k./ 15% R.O.I.	\$/t	23,7	23,7	23,7
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l./ Total /j+k/	\$/t	49,8	48,2	46,6
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m./ Feedstock costs				
1.	\$/t	129,2	99,3	85,2
/NH ₃ /				
2.	\$/t	152,0	123,6	104,8
3.	\$/t	182,6	156,3	131,0

n./ Product value /l+m/ at factory gate				
1.	\$/t	179,0	147,5	131,8
2.	\$/t	201,8	171,8	151,4
3.	\$/t	232,4	204,5	177,6

o./ Distribution cost	\$/t	-	-	-
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p./ Farm-gate price /n+o/	\$/t	-	-	-
	\$/t			
	\$/t			
	\$/t			

Product: Ammonium nitrate

Raw material: coal

Location: Developed site, West-Europe

Capacity	t/d	355	591	2364
On-stream factor	%	90	90	90
Production	kt/y	117	195	780
Total investment cost	M£	10,9	16,2	48,7
<u>Production cost</u>				
<u>Materials</u>	£/t			
lime		0,8	0,8	0,8
coagulating agent		0,6	0,6	0,6
anti-caking agent		1,0	1,0	1,0
MgO		0,8	0,8	0,8
a./ Total materials	£/t	3,2	3,2	3,2
<u>Utilities</u>	£/t			
Power	"	0,7	0,7	0,7
Steam	"	3,6	3,6	3,6
BFW/demineralized/ Cooling water	"	0,8	0,8	0,8
b./ Total utilities	£/t	5,1	5,1	5,1
c./ Labour	£/t	2,1	1,2	0,3
d./ Overhead expenses	£/t	3,2	3,0	0,5
e./ Total/a+b+c+d/	£/t	13,6	12,5	9,1
f./ Depreciation	£/t	9,3	8,3	6,2
g./ Maintenance	£/t	2,8	2,5	1,9
h./ Insurance and property taxes	£/t	1,9	1,7	1,2
i./ Total /f+g+h/	£/t	14,0	12,5	9,3
j./ Total production cost / e+i/	£/t	27,6	25,0	18,4
k./ 15% R.O.I.	£/t	14,0	12,5	9,3
l./ Total /j+k/	£/t	41,6	37,5	27,7
m./ Feedstock costs				
1.	£/t	NH ₃ 94,6	HNO ₃ 137,4	NH ₃ 72,7
2.	£/t	111,3	155,0	90,5
3.	£/t	133,7	178,5	114,4
n./ Product value /l+m/ at factory gate				
1.	£/t	273,6	223,5	191,3
2.	£/t	307,9	259,9	218,7
3.	£/t	353,8	309,0	260,0

Product: AmmoniaRaw material: coalLocation: Developing site, Seaside

Capacity	t/d	150	250	1000
On-stream factor	%	90	90	75
<u>Production</u>	kt/y	50	83	275
Total investment cost	M\$	58,0	78,8	341,5
<u>Production cost</u>				
<u>Materials</u> Chemicals	\$/t	8,0	8,0	8,0

a./ Total materials	\$/t	8,0	8,0	8,0
<u>Utilities</u>	\$/t			
Power	"	33,0	-	3,0
Steam	"	-	-	-
BPW/demineralized/	"	1,8	1,5	1,5
Cooling water	"	16,0	6,9	3,4
b./ Total utilities	\$/t	50,8	8,4	7,9
c./ Labour	\$/t	9,6	5,8	1,9
d./ Overhead expenses	\$/t	24,0	14,5	4,8
e./ Total/a+b+c+d/	\$/t	92,4	36,7	22,6
f./ Depreciation	\$/t	116	94,9	124,2
g./ Maintenance	\$/t	46,4	38,0	49,7
h./ Insurance and property taxes	\$/t	34,8	28,5	37,3
i./ Total /f+g+h/	\$/t	197,2	161,4	211,2
j./ Total production cost / e+i/	\$/t	289,6	198,1	233,8
k./ 15% R.O.I.	\$/t	174,0	142,4	186,3
l./ Total /j+k/	\$/t	463,6	340,5	420,1
m./ Feedstock costs				
4,6 \$/10 ⁶ kcal	1. \$/t	55,2	58,9	47,4
/coal/ 9,1 \$ "	2. \$/t	109,2	114,5	93,7
13,6 \$ "	3. \$/t	163,2	174,1	140,1
n./ Product value /l+m/ at factory gate	1. \$/t	518,8	399,4	467,5
	2. \$/t	572,8	455,0	513,8
	3. \$/t	626,8	514,6	560,2
o./ Distribution cost	\$/t	-	-	-
p./ Farm-gate price /n+o/	\$/t	-	-	-
	\$/t			
	\$/t			
	\$/t			

Appendix 3/1

Product: Urea

Raw material: coal

Location: Developing site, Sesside

Capacity	t/d	260	440	1700
On-stream factor	%	90	90	75
Production	kt/y	86	145	468
Total investment cost	M\$	20,0	30,3	102,5
Production cost				
Materials	\$/t			

a./ Total materials	\$/t	-	-	-
Utilities	\$/t			
Power	"	4,5	4,2	3,9
Steam	"	13,8	13,5	12,6
BP./demineralized/ Cooling water	"	1,4	1,4	1,2
Steam credit	"	-	-	- 0,8
b./ Total utilities	\$/t	19,7	19,1	16,9
c./ Labour	\$/t	1,9	1,1	0,3
d./ Overhead expenses	\$/t	4,8	2,8	0,8
e./ Total/a+b+c+d/	\$/t	26,4	23,0	18,0
f./ Depreciation	\$/t	23,3	20,9	21,9
g./ Maintenance	\$/t	9,3	8,4	8,8
h./ Insurance and property taxes	\$/t	7,0	6,3	6,6
i./ Total /f+g+h/	\$/t	39,6	35,6	37,3
j./ Total production cost / e+i/	\$/t	66,0	58,6	55,3
k./ 15% R.O.I.	\$/t	35,0	31,4	32,9
l./ Total /j+k/	\$/t	101,0	90,0	88,2
m./ Feedstock costs				
1. \$/t		295,7	227,7	266,5
2. \$/t		326,5	259,4	292,9
3. \$/t		357,3	293,3	319,3
/NH ₃ /				
n./ Product value /l+m/ at factory gate				
1. \$/t		396,7	317,7	354,7
2. \$/t		427,5	349,4	381,1
3. \$/t		458,3	383,3	407,5
o./ Distribution cost	\$/t	15,0	15,0	60,0
p./ Farm-gate price /n+o/				
1. \$/t		411,7	332,7	414,7
2. \$/t		442,2	364,4	441,1
3. \$/t		473,3	398,3	467,5

Product: Nitric acidRaw material: coalLocation: Developing site, Sesside

Capacity	t/d	273	455	1822
On-stream factor	%	90	90	75
<u>Production</u>	kt/y	90	150	500
Total investment cost	M\$	18,0	30,0	139,5
<u>Production cost</u>				
<u>Materials</u>	\$/t			
Platina		1,7	1,7	1,7

a./ Total materials	\$/t	1,7	1,7	1,7
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<u>Utilities</u>	\$/t			
Power	"	0,4	0,4	0,4
Steam	"	-	-	-
BPW/demineralized/	"	-	-	-
Cooling water	"	2,2	2,2	2,2
BPW		0,1	0,1	0,1
Steam credit		- 6,0	- 6,0	- 6,0

b./ Total utilities	\$/t	- 3,3	- 3,3	- 3,3
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c./ Labour	\$/t	0,9	0,5	0,2
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d./ Overhead expenses	\$/t	2,3	1,3	0,5
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e./ Total/a+b+c+d/	\$/t	1,6	0,2	- 0,9
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f./ Depreciation	\$/t	20,0	20,0	27,9
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g./ Maintenance	\$/t	8,0	8,0	11,2
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h./ Insurance and property taxes	\$/t	6,0	6,0	8,4
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i./ Total /f+g+h/	\$/t	34,0	34,0	47,5
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j./ Total production cost / e+i/	\$/t	35,6	34,2	46,6
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k./ 15% R.O.I.	\$/t	30,0	30,0	41,9
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l./ Total /j+k/	\$/t	65,6	64,2	88,5
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m./ Feedstock costs				
1. /NH ₃ /	\$/t	145,3	111,8	130,9
2.	\$/t	160,4	127,4	143,9
3.	\$/t	175,5	144,0	156,9

n./ Product value /l+m/ at factory gate				
1.	\$/t	210,9	176,0	219,4
2.	\$/t	226,0	191,6	232,4
3.	\$/t	241,1	208,2	245,4

o./ Distribution cost	\$/t	--	-	-
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p./ Farm-gate price /n+o/	\$/t	-	-	-
	\$/t			
	\$/t			
	\$/t			

Product: Ammonium nitrate

Raw material: coal

Location: Developing site, Seaside

Capacity	t/d	355	591	2364			
On-stream factor	%	90	90	75			
<u>Production</u>	kt/y	117	195	650			
Total investment cost	M\$	13,9	20,5	71,8			
<u>Production cost</u>							
<u>Materials</u>	\$/t						
lime		0,8	0,8	0,8			
coating agent		0,6	0,6	0,6			
anti-caking agent		1,0	1,0	1,0			
MgO		0,8	0,8	0,8			
a./ Total materials	\$/t	3,2	3,2	3,2			
<u>Utilities</u>							
	\$/t						
Power	"	0,7	0,7	0,7			
Steam	"	3,6	3,6	3,6			
BPW/demineralized/	"	-	-	-			
Cooling water	"	0,8	0,8	0,8			
b./ Total utilities	\$/t	5,1	5,1	5,1			
c./ Labour	\$/t	1,1	0,7	0,2			
d./ Overhead expenses	\$/t	2,8	1,8	0,5			
e./ Total/a+b+c+d/	\$/t	12,2	10,8	9,0			
f./ Depreciation	\$/t	11,9	10,5	11,0			
g./ Maintenance	\$/t	4,8	4,2	4,4			
h./ Insurance and property taxes	\$/t	3,6	3,2	3,3			
i./ Total /f+g+h/	\$/t	20,3	17,9	18,7			
j./ Total production cost / e+i/	\$/t	32,5	28,7	27,7			
k./ 15% R.O.I.	\$/t	17,9	15,8	16,5			
l./ Total /j+k/	\$/t	50,4	44,5	44,2			
<u>m./ Feedstock costs</u>							
		NH ₃	HNO ₃	NH ₃	HNO ₃	NH ₃	HNO ₃
1.	\$/t	106,4	162,0	81,9	135,2	95,8	168,5
2.	\$/t	117,4	173,6	93,3	147,1	105,3	178,5
3.	\$/t	128,5	185,2	105,5	160,0	114,8	188,5
<u>n./ Product value /l+m/ at factory gate</u>							
1.	\$/t		318,8		261,6		308,5
2.	\$/t		341,4		284,9		328,0
3.	\$/t		364,1		310,0		347,5
<u>o./ Distribution cost</u>							
	\$/t		15,0		15,0		60,0
<u>p./ Farm-gate price /n+o/</u>							
	\$/t		333,8		276,6		368,5
	\$/t		356,4		299,9		388,0
	\$/t		379,1		325,0		407,5
	\$/t						

<u>Product:</u> Ammonia				
<u>Raw material:</u> coal				
<u>Location:</u> Developing site, Remote				
Capacity	t/d	150	250	1000
On-stream factor	%	90	90	75
<u>Production</u>	kt/y	50	83	275
Total investment cost	M\$	68,0	92,0	444,0
<u>Production cost</u>				
Materials	\$/t			
Chemicals		8,0	8,0	8,0
a./ Total materials	\$/t	8,0	8,0	8,0
<u>Utilities</u>				
	\$/t			
Power	"	33,0	-	3,0
Steam	"	-	-	-
BFW/demineralized/	"	1,8	1,5	1,5
Cooling water	"	16,0	6,9	3,4
b./ Total utilities	\$/t	50,8	8,4	7,9
c./ Labour	\$/t	9,6	5,8	1,9
d./ Overhead expenses	\$/t	24,0	14,5	4,8
e./ Total/a+b+c+d/	\$/t	92,4	36,7	22,6
f./ Depreciation	\$/t	136,0	110,8	161,5
g./ Maintenance	\$/t	54,4	44,3	64,6
h./ Insurance and property taxes	\$/t	40,8	33,2	48,5
i./ Total /f+g+h/	\$/t	231,2	188,3	274,6
j./ Total production cost / e+i/	\$/t	323,6	225,0	297,2
k./ 15% R.O.I.	\$/t	204,0	166,2	242,3
l./ Total /j+k/	\$/t	527,6	391,2	539,5
m./ Feedstock costs				
4,6 \$/10 ⁶ kcal	1. \$/t	55,2	58,9	47,4
/coal/ 9,1 \$ "	2. \$/t	109,2	116,5	93,7
13,6 \$ "	3. \$/t	163,2	174,1	140,1
n./ Product value /l+m/ at factory gate				
	1. \$/t	582,8	450,1	586,9
	2. \$/t	636,8	507,7	633,2
	3. \$/t	690,8	565,3	679,6
o./ Distribution cost	\$/t	-	-	-
p./ Farm-gate price /n+o/				
	\$/t	-	-	-
	\$/t			
	\$/t			

Product: UreaRaw material: coalLocation: Developing site, Remote

Capacity	t/d	260	440	1700
On-stream factor	%	90	90	75
<u>Production</u>	kt/y	86	145	468
Total investment cost	M\$	23,4	35,5	133,2
<u>Production cost</u>				
<u>Materials</u>	\$/t			

a./ Total materials	\$/t	-	-	-
<u>Utilities</u>	\$/t			
Power	"	4,5	4,2	3,9
Steam	"	13,8	13,5	12,6
BFN/demineralized/ Cooling water	"	1,4	1,4	1,2
Steam credit	"	-	-	-0,8
b./ Total utilities	\$/t	19,7	19,1	16,9
c./ Labour	\$/t	1,9	1,1	0,3
d./ Overhead expenses	\$/t	4,8	2,8	0,8
e./ Total/a+b+c+d/	\$/t	26,4	23,0	18,0
f./ Depreciation	\$/t	27,2	24,5	28,5
g./ Maintenance	\$/t	10,9	9,8	11,4
h./ Insurance and property taxes	\$/t	8,2	7,4	8,6
i./ Total /f+g+h/	\$/t	46,3	41,7	48,5
j./ Total production cost / e+i/	\$/t	72,7	64,7	66,5
k./ 15% R.O.I.	\$/t	40,8	36,8	42,8
l./ Total /j+k/	\$/t	113,5	101,5	109,3
m./ Feedstock costs				
/NH ₃ /	1. \$/t	332,2	256,6	334,5
	2. \$/t	363,0	289,4	360,9
	3. \$/t	393,8	322,2	387,4
n./ Product value /l+m/ at factory gate				
	1. \$/t	445,7	358,1	443,8
	2. \$/t	476,5	390,9	470,2
	3. \$/t	507,3	423,7	496,7
o./ Distribution cost	\$/t	15,0	15,0	60,0
p./ Farm-gate price /n+o/				
	1. \$/t	460,7	373,1	503,8
	2. \$/t	491,5	405,9	530,2
	3. \$/t	522,3	438,7	556,7

Product: Nitric acid

Raw material: coal

Location: Developing site, Remote

Capacity	t/d	273	455	1822
On-stream factor	%	90	90	75
Production	kt/y	90	150	500
Total investment cost	M\$	21,3	35,1	181,2
Production cost				
Materials	\$/t			
Platine		1,7	1,7	1,7
a./ Total materials	\$/t	1,7	1,7	1,7
Utilities	\$/t			
Power	"	0,4	0,4	0,4
Steam	"	-	-	-
BPW/demineralized/ Cooling water	"	2,2	2,2	2,2
BPW	"	0,1	0,1	0,1
Steam credit	"	- 6,0	- 6,0	- 6,0
b./ Total utilities	\$/t	- 3,3	- 3,3	- 3,3
c./ Labour	\$/t	0,9	0,5	0,2
d./ Overhead expenses	\$/t	2,3	1,3	0,5
e./ Total/a+b+c+d/	\$/t	1,6	0,2	- 0,9
f./ Depreciation	\$/t	23,7	23,4	36,2
g./ Maintenance	\$/t	9,5	9,4	14,5
h./ Insurance and property taxes	\$/t	7,1	7,0	10,9
i./ Total /f+g+h/	\$/t	40,3	39,8	61,6
j./ Total production cost / e+i/	\$/t	41,9	40,0	60,7
k./ 15% R.O.I.	\$/t	35,6	35,1	54,3
l./ Total /j+k/	\$/t	77,5	75,1	115,0
m./ Feedstock costs				
/NH ₃ /	1. \$/t	163,2	126,0	164,3
	2. \$/t	178,3	142,2	177,3
	3. \$/t	193,4	158,3	190,3
n./ Product value /l+m/ at factory gate	1. \$/t	240,7	201,1	279,3
	2. \$/t	255,8	217,3	292,3
	3. \$/t	270,9	233,4	305,3
o./ Distribution cost	\$/t	-	-	-
p./ Farm-gate price /n+o/	\$/t	-	-	-
	\$/t			
	\$/t			
	\$/t			

Product: Ammonium nitrateRaw material: coalLocation: Developing site, Remote

Capacity	t/d	355	591	2364			
On-stream factor	%	90	90	75			
<u>Production</u>	kt/y	117	195	650			
Total investment cost	M\$	16,2	24,1	93,2			
<u>Production cost</u>							
<u>Materials</u>	\$/t						
lime		0,8	0,8	0,8			
coating agent		0,6	0,6	0,6			
anti-caking agent		0,0	1,0	1,0			
MgO		0,8	0,8	0,8			
a./ Total materials	\$/t	3,2	3,2	3,2			
<u>Utilities</u>	\$/t						
Power	"	0,7	0,7	0,7			
Steam	"	3,6	3,6	3,6			
BPW/demineralized/ Cooling water	"	0,8	0,8	0,8			
b./ Total utilities	\$/t	5,1	5,1	5,1			
c./ Labour	\$/t	1,1	0,7	0,2			
d./ Overhead expenses	\$/t	2,8	1,8	0,5			
e./ Total/a+b+c+d/	\$/t	12,2	10,8	9,0			
f./ Depreciation	\$/t	13,8	12,4	14,3			
g./ Maintenance	\$/t	5,5	5,0	5,7			
h./ Insurance and property taxes	\$/t	4,1	3,7	4,3			
i./ Total /f+g+h/	\$/t	23,4	21,1	24,3			
j./ Total production cost / e+i/	\$/t	35,6	31,9	33,3			
k./ 15% R.O.I.	\$/t	20,7	18,6	21,5			
l./ Total /j+k/	\$/t	56,3	50,5	54,8			
m./ Feedstock costs		NH ₃	HNO ₃	NH ₃	HNO ₃		
1. \$/t		119,5	184,9	92,3	154,4	120,3	214,5
2. \$/t		130,5	296,5	104,1	166,9	129,8	224,5
3. \$/t		141,6	208,1	115,9	179,3	139,3	234,5
n./ Product value /l+m/ at factory gate							
1. \$/t		360,7	297,2	389,6			
2. \$/t		383,3	321,5	409,1			
3. \$/t		406,0	345,7	428,6			
o./ Distribution cost	\$/t	15,0	15,0	60,0			
p./ Farm-gate price /n+o/							
1. \$/t		375,7	312,2	449,6			
2. \$/t		398,3	336,5	468,1			
3. \$/t		421,0	360,7	488,6			

Product: Sulphuric acidRaw material: sulphurLocation: Developed site, West-Europe

<u>Capacity</u>	t/d	200	600
<u>On-stream factor</u>	%	90	90
<u>Production</u>	kt/y	66	200
<u>Total investment cost</u>	M\$	9,7	22,5
<u>Production cost</u>			
<u>Materials</u>	\$/t		

a./ Total materials	\$/t	-	
<u>Utilities</u>	\$/t		
Power	"	1,5	1,5
Steam	"	- 18,0	-18,0
BF ₃ /demineralized/ Cooling water	"	0,7	0,7
b./ Total utilities	\$/t	-15,8	-15,8
c./ Labour	\$/t	3,6	1,5
d./ Overhead expenses	\$/t	5,4	2,3
e./ Total/a+b+c+d/	\$/t	- 6,8	- 12,0
f./ Depreciation	\$/t	14,7	11,3
g./ Maintenance	\$/t	4,4	3,4
h./ Insurance and property taxes	\$/t	3,0	2,2
i./ Total /f+g+h/	\$/t	22,1	16,9
j./ Total production cost / e+i/	\$/t	15,3	4,9
k./ 15% R.O.I.	\$/t	22,1	16,9
l./ Total /j+k/	\$/t	37,4	21,8
m./ Feedstock costs sulphur 90 \$/t	\$/t \$/t \$/t \$/t	29,7	29,7
n./ Product value /l+m/ at factory gate	\$/t \$/t \$/t \$/t	67,1	51,5
o./ Distribution cost	\$/t	-	-
p./ Farm-gate price /n+o/	\$/t \$/t \$/t \$/t	-	-

Product: Sulphuric acid

Raw material: sulphur

Location: Developing site, Seaside

Capacity	t/d	200	600
On-stream factor	%	90	90
Production	kt/y	66	200
Total investment cost	M\$	12,3	28,6
Production cost			
Materials	\$/t		

a./ Total materials	\$/t		
Utilities	\$/t		
Power	"	1,5	1,5
Steam	"	-18,0	-18,0
BP./demineralized/ Cooling water	"	0,7	0,7
b./ Total utilities	\$/t	-15,8	-15,8
c./ Labour	\$/t	0,2	0,2
d./ Overhead expenses	\$/t	0,5	0,5
e./ Total/a+b+c+d/	\$/t	-15,1	-15,1
f./ Depreciation	\$/t	9,5	14,3
g./ Maintenance	\$/t	7,5	5,7
h./ Insurance and property taxes	\$/t	5,6	4,3
i./ Total /f+g+h/	\$/t	22,6	24,3
j./ Total production cost / e+i/	\$/t	7,5	9,2
k./ 15% R.O.I.	\$/t	28,0	21,5
l./ Total /j+k/	\$/t	35,5	30,7
m./ Feedstock costs sulphur 100 \$/t	\$/t \$/t \$/t \$/t	33,0	33,0
n./ Product value /l+m/ at factory gate	\$/t \$/t \$/t \$/t	68,5	63,7
o./ Distribution cost	\$/t	-	-
p./ Farm-gate price /n+o/	\$/t \$/t \$/t \$/t	-	-

Product: Sulphuric acidRaw material: sulphurLocation: Developing site, Remote

Capacity	t/d	200	600
On-stream factor	%	90	90
<u>Production</u>	kt/y	66	200
Total investment cost	M\$	14,4	33,5
<u>Production cost</u>			
<u>Materials</u>	\$/t		

a./ Total materials	\$/t	-	-
<u>Utilities</u>	\$/t		
Power	"	1,5	1,5
Steam	"	-18,0	-18,0
BP./demineralized/ Cooling water	"	0,7	0,7
b./ Total utilities	\$/t	-15,8	-15,8
c./ Labour	\$/t	0,2	0,2
d./ Overhead expenses	\$/t	0,5	0,5
e./ Total/a+b+c+d/	\$/t	-15,1	-15,1
f./ Depreciation	\$/t	21,8	16,8
g./ Maintenance	\$/t	8,7	6,7
h./ Insurance and property taxes	\$/t	6,5	5,0
i./ Total /f+g+h/	\$/t	37,0	28,5
j./ Total production cost / e+i/	\$/t	21,9	13,4
k./ 15% R.O.I.	\$/t	32,7	25,1
l./ Total /j+k/	\$/t	54,6	38,5
m./ Feedstock costs sulphur 100\$/t	\$/t \$/t \$/t \$/t	33,0	33,0
n./ Product value /l+m/ at factory gate	\$/t \$/t \$/t \$/t	87,6	71,5
o./ Distribution cost	\$/t	-	-
p./ Farm-gate price /n+o/	\$/t \$/t \$/t \$/t	-	-

Table 5-2.4

Appendix 3/1

Product: Phosphoric acid

Raw material: phosphate rock

Location:

		Developed site		Developing site	
		West-Europe	SenSide	Remote	
Capacity	t/d	200 /P ₂ O ₅ /	370	/tel-quel/	
On-stream factor	%	90			
Production	kt/y	66 /P ₂ O ₅ /	122,1	/tel-quel/	
Total investment cost	M\$	23,8	30,3	35,5	
Production cost					
Materials	\$/t				
sulphuric acid		151,9	187,9	210,9	
a./ Total materials	\$/t	151,9	187,9	210,9	
Utilities	\$/t				
Power	"	3,5	3,5	3,5	
Steam	"	36,1	36,1	36,1	
BPW/demineralized/ Cooling water	"				
Process water	"	0,1	0,1	0,1	
b./ Total utilities	\$/t	39,7	39,7	39,7	
c./ Labour	\$/t	7,3	3,9	3,9	
d./ Overhead expenses	\$/t	11,0	9,8	9,8	
e./ Total/a+b+c+d/	\$/t	209,9	241,3	264,3	
f./ Depreciation	\$/t	36,1	45,9	53,8	
g./ Maintenance	\$/t	10,0	18,3	21,5	
h./ Insurance and property taxes	\$/t	7,2	13,8	16,2	
i./ Total /f+g+h/	\$/t	54,1	78,0	91,5	
j./ Total production cost / e+i/	\$/t	264,0	319,3	355,8	
k./ 15% R.O.I.	\$/t	54,1	68,9	80,7	
l./ Total /j+k/	\$/t	318,1	388,2	436,5	
m./ Feedstock costs					
phosphate rock	1.15\$/t \$/t	-	49,2	49,2	
	2.30\$/t \$/t	-	98,4	98,4	
	3.50\$/t \$/t	164,0	164,0	164,0	
	4.70\$/t \$/t	229,6			
n./ Product value /l+m/ at factory gate					
	1. \$/t	-	437,4	485,7	
	2. \$/t	-	486,6	534,9	
	3. \$/t	482,1	552,2	600,5	
	4. \$/t	547,1	-	-	
o./ Distribution cost	\$/t	-	-	-	
p./ Farm-gate price /n+o/	\$/t	-	-	-	
	\$/t				
	\$/t				

Product		SSP /13% P ₂ O ₅ /		Developed site		Developing site	
Raw material		phosphate rock		/West-Europe/		Seaside Remote	
Location				500		500	
Capacity		t/d		500		500	
On-stream factor		%		90			
Production		kt/y		160			
Total investment cost	M\$		4,4		5,7		6,6
Production cost							
Materials	\$/t		24,2		24,7		31,5
a./ Total materials	\$/t		24,2		24,7		31,5
Utilities	\$/t		0,2		0,2		0,2
Power	"						
Steam	"						
BPA/demineralized/	"						
Cooling water	"						
b./ Total utilities	\$/t		0,2		0,2		0,2
c./ Labour	\$/t		1,8		1,0		1,0
d./ Overhead expenses	\$/t		2,7		2,5		2,5
e./ Total/a+b+c+d/	\$/t		28,9		28,4		35,2
f./ Depreciation	\$/t		2,8		3,6		4,1
g./ Maintenance	\$/t		0,8		1,4		1,7
h./ Insurance and property taxes	\$/t		0,5		1,1		1,2
i./ Total /f+g+h/	\$/t		4,1		6,1		7,0
j./ Total production cost / e+i/	\$/t		33,0		34,5		42,2
k./ 1% R.O.I.	\$/t		4,1		5,3		6,2
l./ Total /j+k/	\$/t		37,1		39,8		48,4
m./ Feedstock costs							
phosphate rock 1. 15\$/t \$/t			-		8,7		8,7
2. 30\$/t \$/t			-		17,4		17,4
3. 50\$/t \$/t			29,0		29,0		29,0
4. 70\$/t \$/t			40,6		-		-
n./ Product value /l+m/							
at factory gate 1. \$/t			-		48,5		57,1
2. \$/t			-		57,2		65,8
3. \$/t			66,1		68,9		77,4
4. \$/t			77,7		-		-
o./ Distribution cost	\$/t		-		15,0		15,0
p./ Farm-gate price /n+o/	\$/t		-		63,5		72,1
	\$/t		-		72,2		80,9
	\$/t		-		83,8		92,4
	\$/t		-		-		-

Product TSP /46% P₂O₅/

Raw material phosphate rock

Location		Developed site		Developing site	
		/West-Europe/		Senside	Remote
Capacity	t/d	500		500	500
On-stream factor	%	90			
Production	kt/y	160			
Total investment cost	M\$	5,1		6,5	7,6
Production cost					
Materials	\$/t				

a./ Total materials	\$/t				
Utilities	\$/t				
Power	"				
Steam	"	0,2	0,2	0,2	
BPW/demineralized/ Cooling water	"				
b./ Total utilities	\$/t	0,2	0,2	0,2	
c./ Labour	\$/t	1,9	1,0	1,0	
d./ Overhead expenses	\$/t	2,9	2,5	2,5	
e./ Total/a+b+c+d/	\$/t	5,0	3,7	3,7	
f./ Depreciation	\$/t	3,2	4,1	4,8	
g./ Maintenance	\$/t	1,0	1,6	1,9	
h./ Insurance and property taxes	\$/t	0,6	1,2	1,4	
i./ Total /f+g+h/	\$/t	4,8	6,9	8,1	
j./ Total production cost / e+i/	\$/t	9,8	10,6	11,8	
k./ 15% R.O.I.	\$/t	4,8	6,1	7,1	
l./ Total /j+k/	\$/t	16,4	16,7	18,9	
m./ Feedstock costs phosphate rock		Phosph.rock	H ₃ PO ₄	Phosph.rock	H ₃ PO ₄
1. 15\$/t	\$/t	-	-	6,2	143,7
2. 30\$/t	\$/t	-	-	12,3	165,4
3. 50\$/t	\$/t	20,5	163,9	20,5	187,7
4. 70\$/t	\$/t	28,7	186,2	-	-
n./ Product value /l+m/ at factory gate					
1.	\$/t	-	-	171,6	190,2
2.	\$/t	-	-	194,4	213,1
3.	\$/t	200,8	-	224,9	243,6
4.	\$/t	231,3	-	-	-
o./ Distribution cost	\$/t	-	-	15,0	15,0
p./ Farm-gate price /n+o/					
1.	\$/t	-	-	186,6	205,2
2.	\$/t	-	-	209,4	228,1
3.	\$/t	-	-	239,9	258,6
4.	\$/t	-	-	-	-

Product: MAP /12% N + 52% P₂O₅Raw material:Location: Developed site, West-Europe

Capacity	t/d	375
On-stream factor	%	90
<u>Production</u>	kt/y	120
Total investment cost	M\$	8,1
<u>Production cost</u>		
<u>Materials</u>	\$/t	

a./ Total materials	\$/t	
<u>Utilities</u>	\$/t	
Power	"	0,9
Steam	"	0,4
BFW/demineralized/ Cooling water	"	
Fuel		3,0
b./ Total utilities	\$/t	4,3
c./ Labour	\$/t	2,5
d./ Overhead expenses	\$/t	3,8
e./ Total/a+b+c+d/	\$/t	10,6
f./ Depreciation	\$/t	6,8
g./ Maintenance	\$/t	2,0
h./ Insurance and property taxes	\$/t	1,4
i./ Total /f+g+h/	\$/t	10,2
j./ Total production cost / e+i/	\$/t	20,8
k./ 15% R.O.I.	\$/t	10,2
l./ Total /j+k/	\$/t	31,0
m./ Feedstock costs		
ammonia ^{1/}	\$/t	31,4
phosphoric acid ^{1/}	\$/t	255,5
	\$/t	
n./ Product value /l+m/ at factory gate	\$/t \$/t \$/t \$/t	317,9
o./ Distribution cost	\$/t	-
p./ Farm-gate price /n+o/	\$/t \$/t \$/t \$/t	-

1/

With the lowest ammonia cost and the lowest price of phosphate rock

Appendix 3/1

Product: DAP /18% N + 46% P₂O₅/

Raw material:

Location: Developed site, West-Europe

Capacity	t/d	425
On-stream factor	%	90
Production	kt/y	130
Total investment cost	M£	8,1
Production cost		
Materials	£/t	-

a./ Total materials	£/t	-
Utilities	£/t	
Power	"	0,9
Steam	"	0,3
BF ₃ /demineralized/ Cooling water	"	-
Fuel		1,5
b./ Total utilities	£/t	2,7
c./ Labour	£/t	2,3
d./ Overhead expenses	£/t	3,5
e./ Total/a+b+c+d/	£/t	8,5
f./ Depreciation	£/t	6,2
g./ Maintenance	£/t	1,9
h./ Insurance and property taxes	£/t	1,2
i./ Total /f+g+h/	£/t	9,3
j./ Total production cost / e+i/	£/t	17,8
k./ 15% R.O.I.	£/t	9,3
l./ Total /j+k/	£/t	27,1
m./ Feedstock costs	£/t	
ammonia	£/t	47,3
sulphuric acid	£/t	2,1
phosphoric acid	£/t	226,1
n./ Product value /l+m/ at factory gate	£/t £/t £/t £/t	302,6
o./ Distribution cost	£/t	-
p./ Farm-gate price /n+o/	£/t £/t £/t £/t	-

Product: NPK /19:19:19/

Raw material:

Location: Developed site, West-Europe

Capacity	t/d	1040
On-stream factor	%	90
Production	kt/y	320
Total investment cost	M\$	12,5
Production cost		
Materials	\$/t	-

a./ Total materials	\$/t	-
Utilities	\$/t	
Power	"	1,4
Steam	"	1,5
BFW/demineralized/	"	-
Cooling water	"	-
Fuel		2,0
b./ Total utilities	\$/t	4,9
c./ Labour	\$/t	1,1
d./ Overhead expenses	\$/t	1,7
e./ Total/a+b+c+d/	\$/t	7,7
f./ Depreciation	\$/t	3,9
g./ Maintenance	\$/t	1,2
h./ Insurance and property taxes	\$/t	0,8
i./ Total /f+g+h/	\$/t	5,9
j./ Total production cost / e+i/	\$/t	13,6
k./ 15% R.O.I.	\$/t	5,9
l./ Total /j+k/	\$/t	19,5
m./ Feedstock costs		
phosphoric acid	\$/t	92,6
urea	\$/t	41,7
ammonia	\$/t	17,5
potash	\$/t	22,4
n./ Product value /l+m/ at factory gate	\$/t \$/t \$/t \$/t	193,7
o./ Distribution cost	\$/t	-
p./ Farm-gate price /n+o/	\$/t \$/t \$/t \$/t	-

Raw material natural gas	\$/t	Ammonia		Urea		Ammonium nitrate	
		Capacity 150 t/d	250 t/d	Capacity 260 t/d	440 t/d	Capacity 355 t/d	591 t/d
West-Europe							
1./ -	-	-	-	-	-	-	-
2./ 3,5	270	200	174	237	187	193	158
3./ 5,9	288	220	191	248	199	200	167
4./ 11,8	332	269	234	273	227	219	188
5./ 17,6	376	318	276	298	255	238	208
Seaside location							
1./ 1,8	314	232	278	280	222	233	191
2./ 3,5	327	246	290	287	230	238	197
3./ 5,9	345	266	307	297	242	246	206
4./ 11,8	389	316	350	323	270	264	227
5./ -	-	-	-	-	-	-	-
Remote location							
1./ 1,8	352	264	352	314	252	264	219
2./ 3,5	365	279	365	322	260	269	225
3./ 5,9	383	299	382	332	272	277	234
4./ 11,8	427	348	424	357	300	295	255
5./ -	-	-	-	-	-	-	-

Value of 1 t N at factory gate

Raw material: natural gas	<u>U r e a</u> c a p a c i t y			<u>A m m o n i u m n i t r a t e</u> c a p a c i t y		
	260 t/d	440 t/d	1700 t/d	355 t/d	591 t/d	2364 t/d
<u>Seaside location</u>						
1./ 1,8 \$/Gcal	609	483	537	685	562	674
2./ 3,5 "	624	500	552	700	579	688
3./ 5,9 "	646	526	574	724	606	712
4./ 11,8 "	702	587	626	776	668	765
<u>Remote location</u>						
1./ 1,8 \$/Gcal	683	548	674	776	644	859
2./ 3,5 "	700	565	689	791	662	874
3./ 5,9 "	722	591	711	815	688	894
4./ 11,8 "	776	652	763	868	750	947

Table 6-1.2

Product value at factory gate[illegible]

Table 6-1.3

Product value at factory gate[illegible]

Product value at factory gate

			Developed site		Developing site			
			West - Europe		Seaside location		Remote	
			£/t		£/t		£/t	
<u>Sulphuric acid 200 t/d</u>								
sulphur	90 £/t		67,1		-		-	
	100 £/t		-		68,5		87,6	
<u>600 t/d</u>								
sulphur	90 £/t		51,5		-		-	
	100 £/t		-		63,7		71,5	
<u>Phosphoric acid 200 t/d /P₂O₅/</u>			<u>t/100%/</u>	<u>t/54%/</u>	<u>t/100%/</u>	<u>t/54%/</u>	<u>t/100%/</u>	<u>t/54%/</u>
			<u>P₂O₅</u>	<u>P₂O₅</u>	<u>P₂O₅</u>	<u>P₂O₅</u>	<u>P₂O₅</u>	<u>P₂O₅</u>
phosphate rock	1./	15 £/t	-	-	437,4	236,2	435,7	262,3
	2./	30 £/t	-	-	436,6	262,8	534,9	288,8
	3./	50 £/t	482,1	260,3	552,2	298,2	600,5	324,3
	4./	70 £/t	547,7	295,8	-	-	-	-
<u>SSP 500 t/d</u>								
<u>/13% P₂O₅/</u>								
phosphate rock	1./	15 £/t	-	-	48,5		57,1	
	2./	30 £/t	-	-	57,2		65,8	
	3./	50 £/t	66,1		68,3		77,4	
	4./	70 £/t	77,7		-		-	
<u>TSP 500 t/d</u>								
<u>/46% P₂O₅/</u>								
phosphate rock	1./	15 £/t	-		171,6		190,2	
	2./	30 £/t	-		194,4		213,1	
	3./	50 £/t	200,8		224,9		243,6	
	4./	70 £/t	231,3		-		-	
<u>MAP 375 t/d</u>								
<u>/18% N, 52 % P₂O₅/</u>			317,9		-		-	
<u>DAP 425 t/d</u>								
<u>/10 % N, 52% P₂O₅/</u>			302,6		-		-	
<u>NPK 1040 t/d</u>								
<u>/19:19:19/</u>			193,7		-		-	

Farm-gate prices\$/t

Raw material	P r o d u c t					
	U r e a			A m m o n i u m n i t r a t e		
	c a p a c i t y	c a p a c i t y	c a p a c i t y	c a p a c i t y	c a p a c i t y	c a p a c i t y
	260 t/d	440 t/d	1700 t/d	355 t/d	591 t/d	2364 t/d
<u>Natural gas</u>						
<u>Seaside location</u>						
1. 1.8 \$/Gcal	294,7	237,2	306,7	247,5	206,2	289,3
2. 3.5 "	302,2	245,3	313,7	253,1	212,2	294,4
3. 5.9 "	312,4	256,9	323,5	260,5	220,7	301,7
4. 11.8 "	337,6	285,1	347,5	279,1	241,6	319,5
<u>Remote location</u>						
1. 1.8 \$/Gcal	329,3	267,2	370,3	278,7	234,2	351,6
2. 3.5 "	336,6	275,4	377,4	284,1	240,3	356,7
3. 5.9 "	346,8	286,9	387,2	291,6	248,8	364,0
4. 11.8 "	372,1	315,1	411,4	310,3	269,5	381,8
<u>Fuel oil</u>						
<u>Seaside location</u>						
1. 12 \$/Gcal	362,1	306,4	378,6	297,1	257,2	342,0
2. 15 "	375,5	321,3	392,7	307,0	268,2	352,3
<u>Remote location</u>						
1. 12 \$/Gcal	400,1	339,8	448,7	331,0	287,6	409,1
2. 15 \$/Gcal	413,5	354,7	462,8	340,8	298,6	419,5
<u>Coal</u>						
<u>Seaside location</u>						
1. 4.6 \$/Gcal	411,7	332,7	414,7	333,8	276,6	368,5
2. 9.1 "	442,2	364,4	441,1	356,4	299,9	388,0
3. 13.6 "	473,3	398,3	467,5	379,1	325,0	407,5
<u>Remote location</u>						
1. 4.6 \$/Gcal	460,7	373,1	503,8	375,7	312,2	449,6
2. 9.1 "	491,5	405,9	530,2	398,3	336,5	469,1
3. 13.6 "	522,3	438,7	556,7	421,0	360,7	488,6

Table 7-1.2

Farm gate prices of 1 t N		Urea capacity				Ammonium nitrate capacity			
		260 t/d	440 t/d	1700 t/d		355 t/d	591 t/d	2364 t/d	
Raw material: natural gas	Seaside location								
	1./ 1,8 \$/Gcal	641	516	667		728	606	851	
	2./ 3,5 "	657	533	682		744	624	866	
	3./ 5,9 "	679	558	703		766	649	887	
	4./ 11,8 "	734	620	755		821	711	940	
Remote location	1./ 1,8 \$/Gcal	716	581	805		820	689	1034	
	2./ 3,5 "	732	599	820		836	707	1049	
	3./ 5,9 "	754	624	842		858	732	1070	
	4./ 11,8 "	809	685	894		913	793	1123	

Farm-gate prices

\$/t

Developing site

Seaside Remote
location

SSP /500 t/d/

phosph. rock

1.	15	\$/t	63,5	72,1
2.	30	\$/t	72,2	80,8
3.	50	\$/t	83,8	92,4
4.	70	\$/t	-	-

TSP /500 t/d/

phosph. rock

1.	15	\$/t	186,6	205,2
2.	30	\$/t	209,4	228,1
3.	50	\$/t	239,9	258,6
4.	70	\$/t	-	-

Appendix 3/2 - Brief introduction to the use of mathematical programming

This appendix tries to give a short examination on the use of some computer-aided mathematical methods of decision making. No theoretical knowledge of these methods is expected from the reader. This brief inspection attempts to introduce the topic especially from a practical approach. As the theoretical results and practical facilities now provide a rather wide scale of sophisticated techniques, the example to be given below should not be considered characteristic to any real problem neither in its content nor in its technique, it should be taken only as an introductory exercise. In spite of this it may give some insight to the problems of mathematical programming.

Coming to a decision among several possible solutions is always a difficult matter. Among the reasons of this at the first place the troubles of gathering information in its most general sense should be mentioned. Information means not only the necessary technico-economic data to the given problem, it involves the knowledge of the special, local conditions, the expectations or wishes of the various groups and organs.

Appendix 3/2

Respectively, in an investment decision making it is always inevitable to adjust the various viewpoints and interests. For this purpose the elaborating of realistic, treatable model to the problem may give much help. Along this process the conflicting interests may be more objectively expressed through a model and the results drawn from it can be more easily regarded by the participants as reasonable consequences to be taken into consideration.

Some very characteristic problems of economic mathematical modelling are shown below. /The viewpoint of this listing is the necessary special mathematical-computational treatment/:

1. Scheduling of production and sales

Any producing unit may have the problem to find the best structure of production in the best timing and physical settling. The word "best" means either a technical or an economic objective.

2. Transportation problems

Having a table of distances between possible sites special methods are available for the finding of the least total transportation cost.

Appendix 3/2

3. The fix charge problems of productions, sales, etc.

If one can not admit that the cost of production or selling is proportionate to the size of these activities some different methods should be applied. In the most simple case above the fix charges, like the over-all costs, interests, amortization, etc. the further costs may be regarded linear.

4. Investment problems

With investment problems often several questions similar to 1.-3. should be solved simultaneously. From the former parts of this study one can understand the several logical assumptions connected to problems of this kind. In addition, the goals themselves may be rather complex. Here only just some possible separate goals are mentioned /there are some methods of taking more of them into consideration at the same time/:

- maximum of profits,
- minimum of costs,
- maximum of employment
- maximum of the balance of hard currency, etc.

Namely in connection with the modelling of satisfying fertilizer demands it may be useful to take the

Appendix 3/2

following aspects into consideration. There are several possible ways to meet some demand and, even within this, a number of variants may be realized. To make a thorough calculation for their economical results to be expected, all of them would require on the one side roundabout manual work and, on the other side such a calculation would still not necessarily represent the best possible solution /in the economical sense/, it may happen that a relatively small sacrifice /e. g. a little higher investment/ would result a far higher profit.

The problem may be drafted in the following form: what are the possible ways of meeting the demands and their fulfilment most economically, in other words finding the variants that yield supposing nearly equivalent expenditures /such as investment, energies, labour etc./ the highest sum of profit?

The question, however, may be given this way, too: which variant would satisfy the objective at the lowest possible expenditure /investment and production/?

One characteristic type tends to find the most economical product structure of a given unit /considering market conditions/ and to distribute the end product at the lowest possible cost namely with this

Appendix 3/2

present topic - to satisfy the fertilizer demands of a given country, territory, farm etc. most economically.

In such a case, production and investment variants may come from the following:

- the sort of the fertilizer and its raw material,
- its amount,
- the size,
- the technology,
- the site of the plant /plants/ to be established,
- the level of satisfying the demand etc.

It should be supposed that the demand might be fulfilled via buying /importing/ or by production; the plant to be established may have a size just to meet the local demands, but in principle /if motivated by market and other conditions/ it might also provide other selling /e. g. for export/.

The described system is called a multivariable supply model; in order to provide data for it, naturally certain local conditions and technological data must be known, such as the available:

- sorts and quantities of raw materials,
- infrastructure,
- financial resources,
- labour, etc.

Appendix 3/2

The above indicated /and other possible/ factors determine, to a certain extent, the variants to be considered; they are called the constraints.

Accordingly, the model may be written as follows:

$$\text{demand} = \text{production} - \text{export} + \text{import}.$$

Within this, naturally, every factor may note several variants. The computer programme is able to handle all of them simultaneously, and to select, based on the data of the given variants, the solution which is most apt to the objective function. The drawing up of the objective function is always a task of the persons performing the examination and may be, on the basis of the different aspects, rather different.

As for an example which solution gives the lowest costs, the highest sum of profit, or requires the least labour, energy, infrastructure, /depending on the bottle-necks/, etc.?

Thus, the examination or series of examinations made as mentioned gives an answer to the question that which of the possible productions, investments and foreign trade activities /as variants/ are to be performed, in a given period, in order to meet a

Appendix 3/2

certain demand or requirement; what should be their size and proportion that they

- not exceed the limited resources (investment costs, raw materials, labour)
- give a minimum of the costs of a supply or a maximum of the profits (optimum programme).

Should, for some reason, the solution found by the computer programme (e.g., for meeting a demand) require further examination, there is no problem in performing this additional calculation. The numerical data and the objective functions of the model may be varied if necessary but introducing new variables or constraints into the system does not cause any technical obstacle either. One of the basic advantages of this analysing method is that new series of calculations may be quickly performed with rather complex problems, too.

The other advantage is that sensibility analyses may be accomplished, too. These show the effect of the modifying of the most important economic data /costs, prices, etc./ and constraints on the objective function and the optimum programme.

Naturally models are always less or more simplified images of reality and somewhat subjective in

Appendix 3/2

the sense that both the possibilities and the restraints together with their data basis may be disputed, nevertheless subjectivity is mostly limited to this area only. In connection with the compilation of a model the importance of the knowledge and skill of the local experts of the developing country cannot be emphasized enough. While most of the technical-economic data and the several, more or less plausible conditions may be elaborated even by foreign experts, they can not do without the support of the local experts in forming the special, local conditions.

It may be important to mention that even the most precise and complicated models can give an answer only to the questions of the model and not to the real problem. For this reason it is necessary to analyse the results with critics knowing that there were several factors that were not considered at all, or if they were limitations of model-making perhaps they did not render the theoretically best solutions possible.

At last, the building of the model and the changing of some interdepending elements should be a process parallel with the whole course of decision-

Appendix 3/2

making. It ought to have an active role in it. Only this way a model provide useful replies to the given questions, or may be new aspects for further investigations.

First here is an attempt to give a short information of the most widely spread technique called linear programming through presenting a numerical example. After some extentions of this method like the non-linear, the stochastic programming, etc. are shown with some practical remarks.

Let us assume that a country /a branch of industry, a firm, etc./ has the following problem:
which is the relatively best way of satisfying a minimal home supply of a product "A" supposed that this should cause the maximal increase /or if this is not possible the least decrease/ in the balance of hard currency /given e.g. in million US \$/?
There are the possibilities of either a home production, where the surplus may be exported, or of the importation of "A". Let the home production basically depend on one important raw material, called "B" /also in 1000 tons/, where "B" is available.

Appendix 3/2

The specific use of "B" to "A" is a known amount. An other restriction is that both the home production of "A" and "B" and the foreign trade need some given amounts of manpower depending on the size of these activities, and the total of this manpower can not exceed an upper limit /given in persons/.

The per unit costs and incomes of the home productions and the foreign trade activities in the given hard currency /million US \$/ are known as well.

A mathematical programming model generally has three basic elements. 1. the activities, 2. the objective function, and 3. the constraints.

The activities are the unknown variables of the problem. The set of these activities is often called the programme. /The term "mathematical programming" refers to this trying to make distinction from the other everyday meanings of the word "programming" and of the term "computer programming", which is the way of teaching an electronic computer/.

In this example these are only four activities /real great problems may have several thousands of them/:

X_1 = home production of "A",

X_2 = exportation of "A",

Appendix 3/2

x_3 = importation of "A",

x_4 = exportation of "B".

The task is to find the best of all the feasible solutions, the optimal one. The optimum criterion is always formed in an objective function in mathematical programming. Supposed that a unit of an activity causes the following changes in the balance of hard currency /in million US \$/:

x_1 -9 /the cost of producing "A"/

x_2 -12 /the income from the exporting of "A"/

x_3 -14 /the cost of importing "A"/

x_4 + 8 /the income from the exporting of "B"/

Now the objective function will have the following form:

$$y = 9x_1 + 12x_2 - 14x_3 + 8x_4.$$

The optimum /here this means the maximum/ of y is to be founded.

Having no restrictions in connection with the activities, the value of y might be unlimited. The system of these limitations /given in the mathematical form/ are called the constraints of the problem.

This example is supposed to have three constraints:

1. The total consumption of "B" /the use to "A" de-

Appendix 3/2

pending on x_1 and the exportation x_4 should not exceed a supposed given quantity /here, e.g.:20/.
0.4 tons of "B" is needed to produce a unit of "A":

$$0.4x_1 + x_4 \leq 20$$

2. Let the total available manpower be limited /e.g. 370/. Let the following number of persons be required to run a unit of an activity:

$$x_1 \dots\dots\dots 10$$

$$x_2 \dots\dots\dots 2$$

$$x_3 \dots\dots\dots 1$$

$$x_4 \dots\dots\dots 13$$

Supposed that the required manpower is proportional to the scale of any activity the following constraint may be written:

$$10x_1 + 2x_2 + 1x_3 + 13x_4 \leq 370$$

3. The minimal home supply of "A" should reach a supposed given value /here: 40/. This may be statisfied either through home production or foreign trade. Mixed solutions are also allowed:

$$x_1 - x_2 + x_3 \leq 40$$

The problem now is comlete. There are several methods known which are proper for solving this problem. One of the best known of these is called

Appendix 3/2

the Simplex Method. It would not be worth to show here any of these methods in their details because on the one hand it would be difficult to understand them without their mathematical background and on the other hand any of the problems of this type can be solved by well elaborated and tested computer programmes generally available at all the computer centres.

/Real problems with much greater sizes technically are not executable in a manual way./

Any method of linear programming results the optimal solution to the given problem:

$$x_1 = 18.421,$$

$$x_2 = 0$$

$$x_3 = 21.579,$$

$$x_4 = 12.632$$

This optimal programme with the values of the unknown variables substituted into the equation of the objective function /y/ results the following.

$$y = -9 \times 18.421 + 12 \times 0 - 14 \times 21.579 + 8 \times 12.632$$

$$y = - 366.842$$

Appendix 3/2

This programme does not give a positive balance of the hard currency but it is still the best within the given constraints.

It can be seen at this optimal solution, that the importance of the various constraints is not equal.

In other words, if the limits had been a unit less, what an increase would have they caused in the objective function? The computational methods give an answer to this question, too:

1. constraint + 1.842,
2. constraint 0.474,
3. constraint -14.474

Obviously the bottle-neck the problem is the minimum home supply of "A" /the 3rd constraint/

Insisting on a unit increase of this home supply would cause more than 14 million US \$ plus expenditure while on the other hand a unit surplus of the raw material "B" could improve the balance with nearly two million dollars.

Even from this very small example one can feel the problems of model making the execution of the computations and the analysis of the results.

Theoretically, the proportionality of the costs

Appendix 3/2

and incomes to the size of the activity is not a plausible assumption. Some costs, like the fix charges of the foreign trade are quite independent of the turnover. The scale of economy of the investments is not linear either.

These problems may be treated properly through various methods of nonlinear programming. Problems with logical factors (e.g. where more activities are excluding each other/ or problems with given discrete scales /like the possible sizes of investments or the unknown number of machines, etc./ require similar treatment. The difference methods of nonlinear programming try to find optimal solutions to these problems but these methods are much more troublesome, more expensive regarding their practical utilization.

Different solutions may be needed from an even more complicated approach to these questions if one assumes that neither the inputs nor the outputs of the models are fixed /deterministic/ values. Allowing the constants of a model to be probability variables, that is supposing that they are also unsure values with certain mathematical characteristics a stochastic model to the problem may be worked out.

Though probably the nonlinear and stochastic models

Appendix 3/2

give the most appropriate description of the real circumstances, the modelling and especially the mathematical-computational problems are far not sufficiently solved yet. In spite of this one may take such factors into consideration in certain cases. Without any special selecting principle some works dealing with these problems in details are mentioned in Reference.

In the framework of an appendix it is impossible touch all the problems connected to the whole topic. The purpose was only to give some methodological introduction. A basic problem was not mentioned yet, that the well organized cooperation of the special technical, economic and computer experts gives the clue to the application of any of these methods. Only assuming this teamwork it may be guaranteed that the expenses of a computer aided mathematical project return through the more objective, more realistic decisions coming from the variants that one could have not known without these modern facilities.

Appendix 3/2

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Appendix 4/1 - Fertilizer consumption in developing countries in 1976/77 - 1980/81

N - CONSUMPTION

Table 1/1

1000 t N

Category I /less than 1000 t/

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		U	AN		U	AN	
<u>1. AFRICA</u>							
<u>North-West Africa</u>	-			-			
<u>West Africa</u>							
Benin	Cat: II.			0,58	0,4		
Gambia	0,2			Cat: II.			
Guinea	0,6			0,5			
Guinea Bissau	0,1			Cat: II.			
Mauritania	0,5			Cat: II.			
Niger	0,56	0,4		Cat: II.			
Sierra Leone	0,53	0,1 ²		Cat: II.			
Togo	0,95	0,1 ²		Cat: II.			
<u>Central Africa</u>							
Congo	0,12			0,15			
Eq. Guinea	0,1			0,1 ¹			
Gabon	0,38			0,8			
<u>East and Southern Africa</u>							
Botswana	Cat: II.			0,6			
Burundi	0,47		0,2	0,3			
Djibouti	0,5			0,85 ²			
Lesotho	0,3			0,5			
Rwanda	0,16			0,1			
Uganda	0,96		0,3	0,5			

Remarks to all the tables in Appendix 4/1:

1 - Consumption in 1980/81

Source: FAO Fertilizer Yearbook, 1981.

2 - Data from papers prepared for UNIDO Seminar, Lahore, November 1982.

N-CONSUMPTION, 1000 t N
Category I

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		U	AN		U	AN	
<u>2. LATIN AMERICA</u>							
<u>Central America</u>							
Belize	0,3	0,1 ²		0,5			
<u>Caribbean</u>							
Bahamas	0,53			0,5			
St. Kitts-Nevis	0,3			0,4			
St. Lucia	Cat: II.			0,8			
<u>South America</u>							
Fr. Guiana	-			0,2			
Paraguay	0,5			Cat: II.			
<u>3. NEAR EAST</u>							
<u>N.E. Africa</u>							
<u>N.E. Asia</u>							
Kuwait	-			0,28 ²			
Oman	0,13			1,0			
Qatar	0,3			0,84			
U.A. Emirates	1,0			Cat: II.			
Yemen PDR	0,8	0,8		Cat: II.			
<u>4. FAR EAST</u>							
<u>South Asia</u>							
Bhutan	0,1			0,1			

N-CONSUMPTION, 1000 t N
Category I

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		U	AN		U	AN	
<u>East and South-East Asia</u>							
Kampuchea DM	0,1					Cat: III.	
Laos	0,1					Cat: II.	
<u>5. OCEANIA</u>							
Fr. Polynesia	0,2			0,4			
New Caledonia	0,17			0,5			
Samoa	0,01			0,15			

N - C O N S U M P T I O N

1000 t N

Category II /1-10/

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		U	AN		U	AN	
<u>1. AFRICA</u>							
<u>North-West Africa</u>	-			-			
<u>West Africa</u>							
Benin	1,0			Cat: I.			
Gambia	Cat: I.			2,4	0,13		
Guinea Bissau	Cat: I.			1,2			
Liberia	4,3		3,5	2,0 ¹			
Mali	4,5			5,7			
Mauritania	Cat: I.			1,2 ²			
Niger	Cat: I.			1,7			
Senegal	Cat: III.			6,3			
Sierra Leone	Cat: I.			1,3	0,17		
Togo	Cat: I.			1,2	0,51		
Upper Volta	2,2			1,6	0,32		
<u>Central Africa</u>							
Angola	1,0			4,6			
Cameroon	4,0			Cat: III.			
Centr. Afr. Rep.	1,2			1,2			
Chad	3,1			1,6			
Congo	-			-			
Zaire	6,2	6,2		2,5	2,5		

N-CONSUMPTION, 1000 t N
Category II

Name	1976/77				1981/82		Notice
	Total	From Total		Total	From Total		
		U	AN		U	AN	
<u>East and Southern Africa</u>							
Madagascar	3,9	3,3		3,5			
Mauritius	8,8			9,5		1,1	
Mozambique	6,7			Cat: III.			
Reunion	4,1			5,3			
Somalia	...			1,3 ²			
Swaziland	1,0			8,5			
<u>2. LATIN AMERICA</u>							
<u>Central America</u>	-			-			
<u>Caribbean</u>							
Barbados	1,9			2,0			
Dominica	1,6			1,0			
Guadeloupe	3,4	0,43	0,07	3,3	0,02		
Haiti				3,0			
Jamaica	7,3			Cat: III.			
Martinique	3,6	9,18	0,03	4,3	2,9		
St. Lucia	1,6			Cat: I.			
St. Vincent	2,1			2,4			
<u>South America</u>							
Bolivia	1,3			2,7			
Guyana	6,0			9,3	1,8		
Paraguay	6,1			2,3	0,77		
Suriname	3,4			5,4			
Trinidad a. Tobago	4,5			2,8	0,39		

N-CONSUMPTION, 1000 t N
Category II

Name	1976/77		1981/82		Notice
	Total	From Total	Total	From Total	
		U		AN	
<u>3. NEAR EAST</u>					
<u>N.E. Africa</u>	-		-		
<u>N.E. Asia</u>					
Cyprus	6,3		9,0	1,3	2,0
Jordan	4,0		2,9 ²		
Saudi-Arabia	6,4		Cat: IV.		
U.A. Emirates	Cat: I.		2,4 ²	0,7	
Yemen AR	3,4		Cat: III.		
Yemen PDR	Cat:I.		1,7		
<u>4. FAR EAST</u>					
<u>South Asia</u>	-		-		
<u>East and South Asia</u>					
Laos	Cat: I.		4,0		
Mongolia	4,4		7,5		
Singapore	Cat: I.		2,0		
<u>5. OCEANIA</u>					
Fiji	9,0		Cat: III.		

N - C O N S U M P T I O N

1000 t N

Category III /10-40/

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		U	AN		U	AN	
<u>1. AFRICA</u>							
<u>North-West Africa</u>							
Tunisia	24,9			30,5			
<u>West Africa</u>							
Ghana	12,0			15,0			
Ivory Coast	12,0			11,3			
Nigeria	35,0			Cat: V.			
Senegal	10,8			Cat: II.			
<u>Central Africa</u>							
Cameroon	Cat: II.			22,7			
<u>East and Southern Africa</u>							
Ethiopia	11,0			16,0			
Kenya	22,4	1,7	3,5	33,9			2 / 1981/ total: 44 U: 4,8
Malawi	18,9		1,6	14,3			
Mozambique	Cat: II.			20,1			
Tanzania	13,3	2,3	2,3	17,5			
Zambia	39,8			Cat: IV.			
<u>2. LATIN AMERICA</u>							
<u>Central America</u>							
Costa Rica	28,5			Cat: IV.			
Honduras	11,0			16,7			
Nicaragua	22,9			39,0			
Panama	11,0			13,9			

2 / 1981/82
total: 44,
U: 4,8

N-CONSUMPTION, 1000 t N
Category III

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		U	AN		U	AN	
<u>Caribbean</u>							
Dominican Rep.	35,0			31,4			
Jamaica	Cat: II.			10,2	1,7		
<u>South America</u>							
Argentina	39,2			Cat: IV.			
Ecuador	Cat: IV.			34,8			
Uruguay	17,9	5,4		20,4			
<u>3. NEAR EAST</u>							
<u>N.E. Africa</u>							
Libya	13,1			30,5			
<u>N.E. Asia</u>							
Afghanistan	30,6	25,8		25,6			
Cyprus	15,0			Cat: II.			
Iraq	35,0			Cat: IV.			
Lebanon	17,7			16,9			
Yemen AR	Cat: II.			10,6			
<u>4. FAR EAST</u>							
<u>South Asia</u>							
Nepal	10,7	6,3		17,4	12,3		
<u>East and South-East Asia</u>							
Kampuchea DM	Cat: I.			10,5			
<u>5. OCEANIA</u>							
Fiji	Cat: II.			12,8			

N - C O N S U M P T I O N

1000 t N

Category IV /40-70/

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		U	AN		U	AN	
<u>1. AFRICA</u>							
<u>North-West Africa</u>							
Algeria	51,0			71,0			
<u>West Africa</u>	-			-			
<u>Central Africa</u>	-			-			
<u>East and Southern Africa</u>							
Zambia	Cat: III.			57,6			
Zimbabwe	39,8			Cat: VI.			
<u>2. LATIN AMERICA</u>							
<u>Central America</u>							
Costa Rica	Cat: III.			45,2			
El Salvador	Cat: V.			66,5	2,5		
Guatemala	49,9			52,5			
<u>Caribbean</u>	-			-			
<u>South America</u>							
Argentina	Cat: III.			51,2			
Chile	48,7	9,7		48,2	22,1		
Ecuador	49,5			Cat: III.			

N-CONSUMPTION, 1000 t N
Category IV

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		U	AN		U	AN	
<u>3. NEAR EAST</u>							
<u>N.E. Africa</u>	-			-			
<u>N.E. Asia</u>							
Iraq	Cat: III.			63,6		9,9	
Saudi Arabia	Cat: II.			41,3			
Syria	48,1			Cat: V.			
<u>4. FAR EAST</u>							
<u>South Asia</u>							
Sri Lanka	52,3	31,4		Cat: V.			
<u>East and South-East Asia</u>							
Burma	42,9	42,9		Cat: VI.			
<u>5. OCEANIA</u>							

N - C O N S U M P T I O N

1000 t N

Category V /70-100/

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		U	AN		U	AN	
<u>1. AFRICA</u>							
<u>North-West Africa</u>							
Morocco	82,2			81,1			
<u>West Africa</u>							
Nigeria	Cat: III.			96,7			
<u>Central Africa</u>	-			-			
<u>East and Southern Africa</u>	-			-			
<u>2. LATIN AMERICA</u>							
<u>Central America</u>							
El Salvador	77,1			Cat: IV.			
<u>Caribbean</u>	-			-			
<u>South America</u>							
Venezuela	74,3			69,6	32,5	0,5	
<u>3. NEAR EAST</u>							
<u>N.E. Africa</u>	-			-			
Sudan	80,0			74,5			
<u>N.E. Asia</u>							
Syria	Cat: IV.			83,1	15,9	66,0	

N-CONSUMPTION, 1000 t N
Category V

Name	1976/77				1981/82				Notice
	Total	From Total		Total	From Total				
		U	AN		U	AN			

4. FAR EASTSouth Asia

Sri Lanka Cat: IV. 88,9 67,5

East and South-East Asia

Malaysia 90,0 Cat: VI.

5. OCEANIA

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N - C O N S U M P T I O N

1000 t N

Category VI /100-200/

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		U	AN		U	AN	
<u>1. AFRICA</u>							
<u>North-West Africa</u>	-			-			
<u>West Africa</u>	-			-			
<u>Central Africa</u>	-			-			
<u>East and Southern Africa</u>							
Zimbabwe	Cat: IV.			106,7	36,5	69,9	
<u>2. LATIN AMERICA</u>							
<u>Central America</u>	-			-			
<u>Caribbean</u>							
Cuba	187,2			Cat: VII.			
<u>South America</u>							
Colombia	142,7	90,9	7,5	135,3			
Peru	100,3	57,4	26,5	100,6			
<u>3. NEAR EAST</u>							
<u>N.E. Africa</u>	-			-			
<u>N.E. Asia</u>	-			-			
<u>4. FAR EAST</u>							
<u>South Asia</u>							
Bangladesh	167,8	165,8		Cat: VII.			

N-CONSUMPTION, 1000 t N
Category VI

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		U	AN		U	AN	
<u>East and South-East Asia</u>							
Burma	Cat: IV.			110,0	110,0		
Malaysia	Cat: V.			127,9 ²			2 / Total: 139; U: 35,9
Philippines	172,2	103,9		Cat: VII.			
Thailand	136,3			162,0			
Viet Nam	Cat: VII.			199,7			
<u>5. OCEANIA</u>	-			-			

Appendix 4/1

Table 1/7

N - C O N S U M P T I O N

1000 t N

Category VII /Over 200/

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		U	AN		U	AN	
<u>1. AFRICA</u>							
<u>North-West Africa</u>	-			-			
<u>West Africa</u>	-			-			
<u>Central Africa</u>	-			-			
<u>East and Southern Africa</u>	-			-			
<u>2. LATIN AMERICA</u>							
<u>Central America</u>							
Mexico	830,4			1111,7	403,0	46,8	
<u>Caribbean</u>							
Cuba	Cat: VI.			307,1			
<u>South America</u>							
Brazil	498,3	104,0	75,3	667,7			
<u>3. NEAR EAST</u>							
<u>N.E. Africa</u>							
Egypt	427,7	113,5	252,8	585,0			
<u>N.E. Asia</u>							
Iran	220,5	147,7	4,2	386,6			
Turkey	590,7			776,4			

N-CONSUMPTION, 1000 t N
Category VII

Name	1976/77				1981/82				Notice
	Total	From Total		Total	From Total				
		U	AN		U	AN			

4. FAR EASTSouth Asia

Bangladesh	Cat: VI.			250,9	238,6	
India	2351,7	1720,0	178,3	3881,7	3083,0	119,2
Pakistan	554,0	397,0	22,1	832,6	607,0	72,4

East and South-East Asia

China	4755,0			11528,0		
Indonesia	351,2			997,1	929,6	
Korea DPR	385,8			564,1		
Korea Rep	361,3	243,1		431,8	235,3	
Philippines	Cat: VI.			209,9		
Viet Nam	241,5			Cat: VI.		

5. OCEANIA

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P₂O₅ - C O N S U M P T I O N1000 t P₂O₅Category I /less than 1000 t/

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		SSP	TSP		SSP	TSP	
<u>1. AFRICA</u>							
<u>North-West Africa</u>	-			-			
<u>West Africa</u>							
Benin	...			0,35		0,21	
Niger	0,53	0,48	0,007	Cat: II.			
Sierra Leone	0,53			Cat: II.			
Guinea	0,3			Cat: II.			
Mauritania	...			...			
<u>Central Africa</u>							
Centr. Afr. Rep.	0,2			0,03			
Congo	0,1			0,19			
Gabon	0,2			0,14			
<u>East and Southern Africa</u>							
Botswana	1,0			0,8			
Burundi	0,04		0,02	0,4			
Madagascar	0,83		0,62	Cat: II.			
Rwanda	0,08			0,1			
Uganda	0,43			0,1			
Somalia	...			...			
<u>2. LATIN AMERICA</u>							
<u>Central America</u>							
Belize	0,6			0,56			
<u>Caribbean</u>							
Bahamas	0,53			0,4			
Dominica	Cat: II.			0,7			

P₂O₅-CONSUMPTION, 1000 P₂O₅
 Category I

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		SSP	TSP		SSP	TSP	
Haiti	0,1			Cat: II.			
St. Kitts-Nevis	0,5			0,7			
St. Lucia	0,8			0,1			
St. Vincent	0,4			0,5			
<u>South America</u>							
Paraguay	0,3			Cat: II.			
Trinidad a. Tobago	0,27			0,65			
Suriname	0,66			0,3			
<u>3. NEAR EAST</u>							
<u>N.E. Africa</u>	-			-			
Sudan	...			...			
<u>N.E. Asia</u>							
Oman	0,1			0,3			2 / 1981: 0,16
U.A. Emirates	0,1			0,97		0,06	
Yemen AR	0,08			0,9			
Yemen PDR	0,07		0,07	0,08		0,08	
<u>4. FAR EAST</u>							
<u>South Asia</u>	-			-			
<u>East and South-East Asia</u>							
Kampuchea DM	...			Cat: II.			
Singapore	1,0			0,5			
Laos	...			...			
<u>5. OCEANIA</u>							
Fr. Polynesia	0,07			0,3			
New Caledonia	0,06			0,02			
Samoa	...			0,15			

P₂O₅ - C O N S U M P T I O N1000 t P₂O₅Category II /1-10/

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		SSP	TSP		SSP	TSP	
<u>1. AFRICA</u>							
<u>North-West Africa</u>	-			-			
<u>West Africa</u>							
Gambia	1,4			2,8	1,3		
Ghana	5,2			8,0			
Guinea	Cat: I.			1,2			
Ivory Coast	6,3			Cat: III.			
Liberia	1,2			2,4			
Mali	4,2			3,9			
Niger	Cat: I.			1,7			
Senegal	Cat: III.			8,0			
Sierra Leone	Cat: I.			1,3	0,04		
Togo	1,1			1,3	0,05	0,17	
Upper Volta	2,2			2,2			
<u>Central Africa</u>							
Angola	0,6 ⁺			4,8			+ / it is always more than 1,0 except in 1976
Cameroon	2,2			9,0			
Chad	2,0			1,0			
Zaire	5,2		5,2	2,5		2,5	
<u>East and Southern Africa</u>							
Lesotho	1,0			4,0			
Madagascar	Cat: I.			1,4			
Malawi	3,2	0,04	0,09	7,1			

P₂O₅-CONSUMPTION, 1000 t P₂O₅
Category II

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		SSP	TSP		SSP	TSP	
Mauritius	2,3	0,2	0,7	2,9	0,11	0,9	
Mozambique	2,9			Cat: III.			
Reunion	3,7			5,0			
Swaziland	1,5			5,7			
Tanzania	Cat: III.			8,5			

2. LATIN AMERICA

Central America

Honduras	9,0			4,2			
Nicaragua	Cat: III.			7,5			
Panama	4,2			6,3			

Caribbean

Barbados	1,2			1,0			
Dominica	1,3			Cat: I.			
Guadeloupe	3,3		0,13	3,2			
Haiti	Cat: I.			1,4			
Jamaica	1,3			2,9			
Martinique	5,1	0,1		2,7			

South America

Bolivia	1,5			3,5			
Guyana	2,7			3,9			
Paraguay	Cat: I.			4,9	0,1	0,8	

P₂O₅-CONSUMPTION, 1000 t P₂O₅
Category II

Name	1976/77			1981/82		Notice	
	Total	From Total		Total	From Total		
		SSP	TSP		SSP		TSP
<u>3. NEAR EAST</u>							
<u>N.E. Africa</u>	-			-			
<u>N.E. Asia</u>							
Cyprus	10,0			5,5			
Iraq	8,0			Cat: III.			
Jordan	3,2			3,3			
Lebanon	Cat: III.			8,0			
Saudi Arabia	0,5+			Cat: III.		+/ it is always more than 1,0 except in 1976	
<u>4. FAR EAST</u>							
<u>South Asia</u>							
Nepal	2,8			4,0	0,04		
<u>East and South-East Asia</u>							
Burma	6,7		6,7	Cat: IV.			
Kampuchea DM	Cat: I.			7,5			
Mongolia	2,6			6,1			
<u>5. OCEANIA</u>							
Fiji	1,4	1,4		3,3	3,3		
Papua New Guinea	0,7+			2,3		+/ it is always more than 1,0 except in 1976	

P₂O₅ - CONSUMPTION1000 t P₂O₅Category III /10-40/

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		SSP	TSP		SSP	TSP	

1. AFRICANorth-West Africa

Tunesia	26,9			Cat: IV.
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West Africa

Ivory Coast	Cat: II.			11,5
Nigeria	30,0			Cat: V.
Senegal	16,4			Cat: II.

Central Africa

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East and Southern Africa

Ethiopia	16,2			30,0
Kenya	27,3		6,3	36,0 ² 2,8 3,7
Mozambique	Cat: II.			15,0
Tanzania	11,0		5,6	Cat: II.
Zambia	17,9			21,1

2. LATIN AMERICACentral America

Costa Rica	10,4			12,0
El Salvador	16,4			20,1
Guatemala	26,7			27,8
Nicaragua	14,0			Cat: II.

P₂O₅-CONSUMPTION, 1000 t P₂O₅
Category III

Name	1976/77				1981/82		Notice
	Total	From Total		Total	From Total		
		SSP	TSP		SSP	TSP	
<u>Caribbean</u>							
Dominican Rep	21,4			11,0			
<u>South America</u>							
Argentina	34,8			40,0			
Ecuador	13,3			15,7			
Peru	17,0	1,6	3,3	18,3	1,6	7,2	
<u>3. NEAR EAST</u>							
<u>N.E. Africa</u>							
Libya	26,6			Cat: IV.			
<u>N.E. Asia</u>							
Afghanistan	13,6		1,1	11,1			
Iraq	Cat: II.			13,1			
Lebanon	12,0			Cat: II.			
Saudi Arabia	Cat: II.			23,6			
Syria	20,5		20,5	Cat: IV.			
<u>4. FAR EAST</u>							
<u>South Asia</u>							
Sri Lanka	14,5			29,9		17,3	
<u>East and South-East Asia</u>							
Viet Nam	Cat: V.			28,2			
<u>5. OCEANIA</u>							
	-			-			

P2O5 - CONSUMPTION

1000 t P2O5

Category IV /40-70/

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		SSP	TSP		SSP	TSP	
<u>1. AFRICA</u>							
<u>North-West Africa</u>							
Tunisia	Cat: III.			49,1			
<u>West Africa</u>	-			-			
<u>Central Africa</u>	-			-			
<u>East and Southern Africa</u>							
Zimbabwe	43,0			45,4	31,3	14,1	
<u>2. LATIN AMERICA</u>							
<u>Central America</u>	-			-			
<u>Caribbean</u>							
Cuba	52,5			Cat: V.			
<u>South America</u>							
Chile	59,1	2,9	37,2	52,6			35,6
Colombia	68,9			Cat: V.			
Uruguay	52,1	9,9	1,7	39,7			
Venezuela	46,8			45,8			2,2
<u>3. NEAR EAST</u>							
<u>N.E. Africa</u>							
Egypt	66,4	66,4		Cat: VI.			
Libya	Cat: III.			45,0			

P₂O₅-CONSUMPTION, 1000 t P₂O₅
Category IV

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		SSP	TSP		SSP	TSP	
<u>N.E. Asia</u>							
Syria	Cat: III.			46,4		42,2	
<u>4. FAR EAST</u>							
<u>South Asia</u>							
Bangladesh	61,1		61,1	Cat: VI.			
<u>East and South-East Asia</u>							
Burma	Cat: II.			45,0		45,0	
Malaysia	67,7			Cat: V.			
Philippines	40,0			51,2			
<u>5. OCEANIA</u>							
	-			-			

Appendix 4/1

P₂O₅ - CONSUMPTION

1000 t P₂O₅

Table 2/5

Category V /70-100/

Name	1976/77				1981/82			Notice
	Total	From Total		Total	From Total			
		SSP	TSP		SSP	TSP		

1. AFRICA

North-West Africa

Algeria	85,0			92,3			
Morocco	72,4			78,8			

West Africa

Nigeria	Cat: III.			79,5			
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<u>Central Africa</u>	-			-			
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<u>East and Southern Africa</u>	-			-			
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2. LATIN AMERICA

<u>Central America</u>	-			-			
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Caribbean

Cuba	Cat: IV.			80,1			
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South America

Colombia	Cat: IV.			75,9			
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3. NEAR EAST

<u>N.E. Africa</u>	-			-			
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<u>N.E. Asia</u>	-			-			
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P₂O₅-CONSUMPTION, 1000 t P₂O₅
 Category V

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		SSP	TSP		SSP	TSP	
<u>4. FAR EAST</u>							
<u>South Asia</u>	-			-			
<u>East and South-East Asia</u>							
Malaysia	Cat: IV.			98,6		2,3	
Thailand	80,3			Cat: VI.			
Viet Nam	95,0			Cat: III.			
<u>5. OCEANIA</u>	-			-			

P₂O₅ - C O N S U M P T I O N

1000 t P₂O₅

Category VI /over 100/

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		SSP	TSP		SSP	TSP	
<u>1. AFRICA</u>							
<u>North-West Africa</u>	-			-			
<u>West Africa</u>	-			-			
<u>Central Africa</u>	-			-			
<u>East and Southern Africa</u>	-			-			
<u>2. LATIN AMERICA</u>							
<u>Central America</u>							
Mexico	235,9	58,0	69,8	384,2	73,3	87,0	
<u>Caribbean</u>	-			-			
<u>South America</u>							
Brazil	1308,3	262,0	471,7	1312,7			
<u>3. NEAR EAST</u>							
<u>N.E. Africa</u>							
Egypt	Cat: IV.			110,0	110,0		
<u>N.E. Asia</u>							
Iran	161,5			289,4			
Turkey	521,9			495,3			
<u>4. FAR EAST</u>							
<u>South Asia</u>							
Bangladesh	Cat: IV.			119,4		95,9	
India	649,5	139,2	0,9	1172,1	187,0	20,9	
Pakistan	117,9	13,6	0,7	225,5	19,4		

P₂O₅-CONSUMPTION, 1000 t P₂O₅
Category VI

Name	1976/77			1981/82			Notice
	Total	From Total		Total	From Total		
		SSP	TSP		SSP	TSP	
<u>East and South-East Asia</u>							
China	1491,0			2931,3			
Indonesia	111,4			320,4		296,2	
Korea DPR	127,0			130,0			
Korea Rep	142,1		14,1	137,8	2,2		
Thailand	Cat: V.			126,2			
<u>5. OCEANIA</u>	-			-			

K₂O - C O N S U M P T I O N

1000 t K₂O

Category I /less than 1000 t/

Name	1976/77	1981/82	Notice
<u>1. AFRICA</u>			
<u>North-West Africa</u>			
	-	-	
<u>West Africa</u>			
Gambia	0,9	0,5	
Guinea	0,4	Cat: II.	
Guinea Bissau	0,1	0,04 ¹	
Liberia	0,4	0,7	
Niger	0,07	0,43 ¹	
Mauritania	...	0,2 ¹	
Sierra Leone	0,22	0,73	
Togo	0,8	0,96	
Upper Volta	0,4	Cat: II.	
<u>Central Africa</u>			
Angola	0,5	Cat: II.	
Centr. Afr. Rep.	0,2	0,03	
Congo	Cat: II.	0,2	
Gabon	0,3	0,6	
<u>East and Southern Africa</u>			
Burundi	0,03	0,4	
Djibouti	0,7	Cat: II.	
Ethiopia	...	0,2 ¹	
Kenya	0,4	0,7	
Mozambique	Cat: II.	0,9	
Rwanda	0,08	0,1	
Uganda	0,26	...	

K₂O-CONSUMPTION, 1000 t K₂O
Category I

Name	1976/77	1981/82	Notice
<u>2. LATIN AMERICA</u>			
<u>Central America</u>			
Belize	...	0,4	
<u>Caribbean</u>			
Bahamas	0,5	0,3	
Haiti	0,1	Cat: II.	
St. Lucia	0,8	0,1	
St. Vincent	0,1	1,0	
<u>South America</u>			
Bolivia	0,1	0,7	
Fr. Guyana	-	0,2	
Paraguay	0,2	Cat: II.	
Suriname	0,2	0,3	
<u>3. NEAR EAST</u>			
<u>N.E. Africa</u>			
Sudan	-	0,2	
<u>N.E. Asia</u>			
Afghanistan	-	0,1	
Iraq	...	0,1	
Jordan	0,8	Cat: II.	
Kuwait	-	0,1	
Oman	0,2	0,3	
Saudi Arabia	0,16	Cat: II.	
Syria	0,96	Cat: II.	
U.A. Emirates	-	0,33	
Yemen AR	...	0,6	
Yemen PDR	0,05	...	

K₂O-CONSUMPTION, 1000 t K₂O
Category I

Name	1976/77	1981/82	Notice
<u>4. FAR EAST</u>			
<u>South Asia</u>			
Nepal	Cat: II.	0,6	
<u>East and South-East Asia</u>	-	-	
<u>5. OCEANIA</u>			
Fr. Polynesia	0,2	0,3	
New-Caledonia	0,01	0,06	
Samoa	...	0,15	

K₂O - C O N S U M P T I O N

1000 t K₂O

Category II /1-10/

Name	1976/77	1981/82	Notice
<u>1. AFRICA</u>			
<u>North-West Africa</u>			
Tunisia	2,5	4,3	
<u>West Africa</u>			
Benin	1,0	1,9	
Ghana	3,3	8,0	
Guinea	Cat. I.	1,1	
Mali	3,1	3,5	
Upper Volta	Cat: I.	1,3	
<u>Central Africa</u>			
Angola	Cat: I.	2,7	
Cameroon	6,9	Cat: III.	
Chad	3,1	1,6	
Congo	2,5	Cat: I.	
Zaire	1,3	2,6	
<u>East and Southern Africa</u>			
Djibouti	Cat: I.	1,1	
Madagascar	4,1	2,1	
Malawi	4,8	3,2	
Mauritius	Cat: III.	9,95	
Mozambique	1,6	Cat: I.	
Reunion	3,5	4,8	
Swaziland	2,4	5,2	
Tanzania	6,4	3,1	
Zambia	6,1	6,7	

Category II /1-10/

Name	1976/77	1981/82	Notice
<u>2. LATIN AMERICA</u>			
<u>Central America</u>			
El Salvador	8,7	1,8	
Honduras	5,4	Cat: III.	
Panama	7,5	Cat: III.	
<u>Caribbean</u>			
Barbados	1,7	3,0	
Dominica	2,3	1,4	
Guadeloupe	3,2	3,2	
Haiti	Cat: I.	1,4	
Jamaica	5,7	5,9	
Martinique	2,5	6,9	
St. Kitts-Nevis	1,2	1,3	
<u>South America</u>			
Argentina	4,2	5,3	
Guyana	1,8	4,7	
Paraguay	Cat: I.	2,1	
Trinidad a. Tobago	2,7	3,1	
Uruguay	4,0	3,5	
<u>3. NEAR EAST</u>			
<u>N.E. Africa</u>			
Egypt	2,8	Cat: III.	
Libya	3,7	2,7	

K₂O-CONSUMPTION, 1000 t K₂O
Category II

Name	1976/77	1981/82	Notice
<u>N.E. Asia</u>			
Cyprus	3,1	1,4	
Iran	2,7	...	
Jordan	Cat: I.	1,0	
Lebanon	2,4	Cat: III.	
Saudi-Arabia	Cat: I.	2,3	
Syria	Cat: I.	4,1	
<u>4. FAR EAST</u>			
<u>South Asia</u>			
Nepal	1,4	Cat: I.	
Pakistan	2,4	Cat: III.	
<u>East and South-East Asia</u>			
Burma	1,5	Cat: III.	
Kampuchea DM	...	1,0	
Singapore	1,0	2,2	
<u>5. OCEANIA</u>			
Fiji	2,2	2,7	
Papua New Guinea	1,8	2,4	

K₂O - C O N S U M P T I O N

1000 t K₂O

Category III /10-40/

Name	1976/77	1981/82	Notice
<u>1. AFRICA</u>			
<u>North-West Africa</u>			
Algeria	30,0	33,4	
Morocco	32,2	40,3	
<u>West Africa</u>			
Ivory Coast	19,0	29,0	
Nigeria	14,0	37,0	
Senegal	12,7	10,0	
<u>Central Africa</u>			
Cameroon	Cat: II.	10,2	
<u>East and Southern Africa</u>			
Mauritius	10,3	Cat: II.	
Zimbabwe	18,9	30,4	
<u>2. LATIN AMERICA</u>			
<u>Central America</u>			
Costa Rica	16,8	17,0	
Guatemala	17,9	18,5	
Honduras	Cat: II.	10,1	
Nicaragua	11,0	13,8	
Panama	Cat: II.	10,0	
<u>Caribbean</u>			
Dominican Rep	19,4	15,8	

K₂O-CONSUMPTION, 1000 t K₂O
Category III

Name	1976/77	1981/82	Notice
<u>South America</u>			
Chile	13,2	11,0	
Colombia	34,5	Cat: IV.	
Ecuador	18,6	18,1	
Peru	11,6	12,8	
Venezuela	39,9	30,3	
<u>3. NEAR EAST</u>			
<u>N.E. Africa</u>			
Egypt	Cat: II.	12,9	
<u>N.E. Asia</u>			
Lebanon	Cat: II.	10,3	
Turkey	28,9	22,0	
<u>4. FAR EAST</u>			
<u>South Asia</u>			
Bangladesh	14,5	28,1	
Pakistan	Cat: II.	21,8	
Sri Lanka	28,5	Cat: IV.	
<u>East and South-East Asia</u>			
Burma	Cat: II.	11,0	
Indonesia	30,0	Cat: VI.	
Korea DPR	37,7	Cat: V.	
Thailand	20,5	35,6	
Viet Nam	34,2	22,1	
<u>5. OCEANIA</u>			
	-	-	

Appendix 4/1

Table 3/4

K₂O - C O N S U M P T I O N

1000 t K₂O

Category IV /40-70/

Name	1976/77	1981/82	Notice
<u>1. AFRICA</u>			
<u>North-West Africa</u>	-	-	
<u>West Africa</u>	-	-	
<u>Central Africa</u>	-	-	
<u>East and Southern Africa</u>	-	-	
<u>2. LATIN AMERICA</u>			
<u>Central America</u>			
Mexico	54,0	65,1	
<u>Caribbean</u>	-	-	
<u>South America</u>			
Colombia	Cat: III.	70,0	
<u>3. NEAR EAST</u>			
<u>N.E. Africa</u>	-	-	
<u>N.E. Asia</u>	-	-	
<u>4. FAR EAST</u>			
<u>South Asia</u>			
<u>Sri Lanka</u>	Cat: III.	47,0	
<u>East and South-East Asia</u>			
Philippines	51,5	60,7	
<u>5. OCEANIA</u>	-	-	

Appendix 4/1

Table 3/5

K₂O - C O N S U M P T I O N

1000 t K₂O

Category V /70-100/

Name	1976/77	1981/82	Notice
<u>1. AFRICA</u>			
<u>North-West Africa</u>	-	-	
<u>West Africa</u>	-	-	
<u>Central Africa</u>	-	-	
<u>East and Southern Africa</u>	-	-	
<u>2. LATIN AMERICA</u>			
<u>Central America</u>	-	-	
<u>Caribbean</u>	-	-	
<u>South America</u>	-	-	
<u>3. NEAR EAST</u>			
<u>N.E. Africa</u>	-	-	
<u>N.E. Asia</u>	-	-	
<u>4. FAR EAST</u>			
<u>South Asia</u>	-	-	
<u>East and South-East Asia</u>			
Korea DPR	Cat: III.	92,0	
<u>5. OCEANIA</u>	-	-	

K₂O - C O N S U M P T I O N

1000 t K₂O

Category VI /over 100/

Name	1976/77	1981/82	Notice
<u>1. AFRICA</u>			
<u>North-West Africa</u>	-	-	
<u>West Africa</u>	-	-	
<u>Central Africa</u>	-	-	
<u>East and Southern Africa</u>	-	-	
<u>2. LATIN AMERICA</u>			
<u>Central America</u>	-	-	
<u>Caribbean</u>			
Cuba	115,9	213,6	
<u>South America</u>			
Brazil	721,5	766,6	
<u>3. NEAR EAST</u>			
<u>N.E. Africa</u>	-	-	
<u>N.E. Asia</u>	-	-	
<u>4. FAR East</u>			
<u>South Asia</u>			
India	377,3	670,4	
<u>East and South-East Asia</u>			
China	174,0	681,1	
Indonesia	Cat: III.	136,2	
Korea Rep	139,8	199,1	
Malaysia	141,1	173,6	
<u>5. OCEANIA</u>	-	-	

Appendix 4/2 - Classification of developing countries according to their fertilizer consumption

Table 1

Countries according to their annual consumption of fertilizers

Consumption rates, tonnes of nutrient	Nitrogenous						Phosphate						Potassium					
	1980/81		1986/87		11980/81		1986/87		1980/81		1986/87		1980/81		1986/87		1980/81	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Up to 10.000	40	43	29	31	-12	50	54	42	46	-8	62	67	56	61	-6			
10.000-30.000	16	17	18	20	+3	12	13	15	16	+3	14	15	15	16	+1			
30.000-60.000	9	10	12	13	+3	11	12	12	13	+1	7	8	9	10	+2			
60.000-100.000	8	9	8	8	0	6	7	8	9	+2	4	4	5	5	+1			
Over 100.000	19	21	25	27	+6	13	14	15	16	+2	5	6	7	8	+2			

Table 2

Countries according to their per hectare consumption of fertilizers

Consumption rates, tonnes of nutrient	Nitrogenous						Phosphate						Potassium					
	1980/81			1986/87 ^x			1980/81			1986/87 ^x			1980/81			1986/87 ^x		
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Up to 10.000	47	51	43	47	-4	59	64	49	53	11	74	80	72	78	-2			
10.000-30.000	28	30	20	22	-8	30	33	28	30	-3	13	13	13	14	+1			
30.000-60.000	10	19	18	20	+9	2	2	11	12	+10	3	4	5	5	+1			
Over 60.000	7	8	11	11	+3	1	1	4	5	+4	2	3	2	3	0			

^{x/} Consumption of nutrient per hectare has been calculated dividing the forecasted demand in 1986/87 by arable and permanent crop area in 1980/81.

Appendix 4/3 - Raw material potential in
developing countries

Table 1

Production of natural gas and reserves in the
developing countries

10^9 cu m

C o u n t r y	Production a./ 1982	Reserves c./ 1982
<u>1. AFRICA</u>		
<u>North-West Africa</u>		
Algeria	23,46	3150
Morocco	0,10	1 ^{d./}
Tunisia	0,44	122
<u>West Africa</u>		
Nigeria	1,94	918
<u>Central Africa</u>		
Angola	0,24	42
Cameroon		126
Congo		76
Cabon	0,14	14
Zaire		1
<u>East and Southern Africa</u>		
Tanzania	-	6

Appendix 4/3

Table 1 /cont'd/
10⁹cu m

C o u n t r y	Production a./ 1982	Reserves c./ 1982
---------------	---------------------------	-------------------------

Central America

Mexico	43,89	2148
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South America

Argentina	10,94	714
Bolivia	2,79	160
Brazil	3,02	66
Chile	5,05	70
Colombia	2,96	130
Ecuador	0,05	116
Peru	0,95	34
Venezuela	14,93	1532
Trinidad and Tobago	2,41	312

3. NEAR EAST

N.E. Africa

Egypt	2,45	203
Libya	4,34	609
Sudan		1 ^{d./}

N.E. Asia

Afghanistan	4,49	54 ^{e./}
Bahrain	5,07	223
Iran	10,80	13.667

C o u n t r y	Production	Reserves
	a./ 1982	c./ 1982
Iraq	0,65	816
Kuwait	3,79	847
Oman	2,14	76
Qatar	3,64	1756
Saudi-Arabia	16,73	3313
Syria	0,24	36
Turkey	0,10	15 ^{e./}
U.A. Emirates	13,44 ^{b./}	810

4. FAR EAST

South Asia

Bangladesh	1,03 ^{b./}	198
India	2,31	411
Pakistan	8,93	525

East and South-East Asia

Burma	0,48	5
China	10,31	844
Indonesia	16,11	838
Malaysia and Brunei	10,74	1155
Thailand		312

- a./ Unless indicated otherwise data taken from International Petroleum Encyclopedia 1983, Pennwell Publishing Co., Box 1260, Tulsa, Oklahoma 74101, 1983. p. 318.
- b./ Statistics Review 1983, Energy Economics Research Ltd. 6. May 1983. pp. 8-9.
- c./ Unless indicated otherwise data taken from International Petroleum Encyclopedia 1983, ep.cit.
- d./ Proven reserves as of 1. January 1981. Petroleum Economist, August 1981.
- e./ Statistics Review 1983, Energy Economics Research Ltd, 6. May 1983. pp. 4-5.

Crude oil production, reserves and refining
capacities in the developing countries

10⁶ t

C o u n t r y	Production	Reserves	Refining capacity
	a	a	a
	1982	1982	1982
<u>1. AFRICA</u>			
<u>North-West Africa</u>			
Algeria	37,50	850	4,6
Morocco	0,01	small ^c	3,7
Tunisia	5,30	167	1,7
<u>West Africa</u>			
Gambia		exploration under constr ^c	
Ghana	0,08	small	1,3
Guinea			available ^c
Ivory Coast	0,45	10	4,5
Mali		discovery ^c	
Mauritania		discoveries probable ^c	
Nigeria	66,20	1508	13,0
Senegal		100	0,9
Sierra Leone			0,5
<u>Central Africa</u>			
Angola	6,10	147	1,6
Cameroon	5,45	48	2,2
Chad		20	small planed ^c
Congo	4,35	140	...
Gabon	6,50	41	1,0
Zaire	1,10	13	0,9

C o u n t r y	Production a 1982	Reserves a 1982	Refining capacity a 1982
---------------	-------------------------	-----------------------	-----------------------------------

East and Southern Africa

Ethiopia		unidentified ^c	0,7
Kenya			4,0
Madagascar		shale available ^c	0,8
Mozambique			0,8
Somalia		available ^c	
Tanzania			0,9
Zambia			1,2
Zimbabwe		available ^c	

2. LATIN AMERICA

Costa Rica			0,8
El Salvador			0,8
Guatemala	0,32	4,0	0,8
Honduras			0,7
Mexico	136,7	4347	64,5
Nicaragua			0,7
Panama		exploration ^c	5,0

Caribbean

Barbados	0,03	small	0,2
Cuba	0,36 ^{b./}		
Dominican Rep			2,4
Jamaica			1,8

Appendix 4/3

Table 2 /cont'd/
10⁶ t

C o u n t r y	Production a 1982	Reserves a 1982	Refining capacity a 1982
<u>South America</u>			
Argentina	24,15	233	33,8
Bolivia	1,20	16	3,0
Brazil	12,60	158	61,0
Chile	2,05	68	7,0
Colombia	7,00	48	10,7
Ecuador	10,75	126	4,0
Paraguay			0,4
Peru	9,90	75	8,4
Uruguay			2,3
Venezuela	91,30	1935	64,2
Trinidad a. Tobago	9,10	52	18,8
<u>3. NEAR EAST</u>			
<u>N.E. Africa</u>			
Egypt	33,35	300	17,0
Libya	56,35	1935	6,5
Sudan		36	1,2
<u>N.E. Asia</u>			
Bahrain	2,25	18	12,5
Iran	94,80	4978	26,5
Iraq	45,70	3690	8,4
Kuwait	33,75	5780	31,2
Lebanon			2,6
Oman	16,40	246	2,3
Qatar	17,00	308	0,59
Saudi-Arabia	324,20	14616	35,3

Appendix 4/3

Table 2 /cont'd/
10⁶ t

C o u n t r y	Production a 1982	Reserves a 1982	Refining capacity a 1982
Syria	8,75	137	11,4
Turkey	2,25	25	23,4
U.A. Emirates	62,35	2912	6,8
Yemen PDR		naphtha and refinery gases available ^c	8,9

4. FAR EAST

Bangladesh			1,6
India	19,20	307	37,6
Pakistan	0,60	18	6,7

East and South-East Asia

Burma	1,50	3	1,3
China	101,00	1754	100,0
Indonesia	67,05	860	17,1
Korea Rep			37,7
Malaysia-Brunei- -Singapore	23,05	141	8,8
Philippines	0,35	3	14,3
Thailand	0,30	9	8,8

a - Unless indicated otherwise data taken from International Petroleum Encyclopedia 1983, Pennwell Publishing Co; Box 1260, Tulsa, Oklahoma 74101.

b - Petroleum Economist, January 1983.

c - Fertilizers in developing countries, potential for setting up mini-fertilizer plants, Draft III/July 1982/ E.Z. Unido.

Coal^a production and reserves in the
developing countries

10⁶ t

C o u n t r y	Production 1981 c	Known economic d	Additional d	Total d
<u>1. AFRICA</u>				
<u>North-West africa</u>				
Morocco	0,059	''	90	40 /1979/
<u>West Africa</u>				
Benin				lignite ^{b./}
Nigeria	0,014	338	24	362 /1979/
Sierra Leone				lignite ^{b./}
Mali			3	3 /1979/
<u>Central Africa</u>				
Angola				38 ^{b./}
Cameroon				50 ^{b./}
Zaire				1180 ^{b./}
<u>East and Southern Africa</u>				
Botswana	0,032			500 ^{b./}
Ethiopia			1	1 /1966/
Madagascar		75/1977/	...	400 ^{b./}
Malawi				50 ^{b./}
Mozambique	0,038	100	300	400 /1969/
Tanzania				250 ^{b./}
Zambia	0,042			228 ^{b./}
Zimbabwe	0,231	965/1977/		

Appendix 4/3

Table 3 /cont'd/
10⁶ t

C o u n t r y	Production 1981 c	Known economic d	Additional d	Total d
<u>2. LATIN AMERICA</u>				
<u>Central America</u>				
Honduras		21/1979/		
Mexico		480	500	980/1979/
<u>Caribbean</u>				
Haiti		13	27	40/1979/
<u>South America</u>				
Argentina	0,042	150	9750	9900/1978/
Brazil	0,474	1320	12770	14090/1978/
Chile	0,063	1150	4135	5385/1979/
Colombia		48	790	838/1979/
Ecuador			36	36/1979/
Peru			100 /1979/	
Venezuela	0,004	17	4300	4317/1979/
<u>3. NEAR EAST</u>				
<u>N.E. Asia</u>				
Jemen		1	...	1
Turkey	1,467	3923	280	4203/1978/
<u>4. FAR EAST</u>				
<u>South Asia</u>				
Bangladesh			3	3/1979/
India	10,756	1869	281	2150/1978/
Pakistan	0,133	646/1972/	...	...

APPENDIX 4/3

Table 3 /cont'd/
10⁵ t

C o u n t r y	Production Known 1981 c	economic d	Additional d	Total d
<u>5. EAST and SOUTH-EAST ASIA</u>				
Burma		...	80/1975/	...
China		...	40500	...
Indonesia	0,040	661	18209	18870/1979/
Korea Rep	1,532			
Korea DPR		300	2200	2500
Malaysia			250	250/1978/
Viet Nam		12/1965/	...	...
Thailand	0,164	246/1978/	...	...
Philippines		170/1979/	...	...

- a./ The figures relate to all grades of anthracite, bituminous coal, brown coal and lignite.
- b./ Source: Fertilizers in developing countries; potential for setting up mini-fertilizerplants.
Draft III. /July 1982/ E.Z. UNIDO
- c./ Monthly Bulletin of Statistics, Vol. XXXVII N° 8, Aug. 1983.
United Nations, New York.
- d./ 1980 Yearbook of World Energy Statistics, United Nations,
New York, 1981.

Production of phosphate rock and reserves in the
developing countries

C o u n t r y	Production ^a 10 ³ t P ₂ O ₅	Total reserves 10 ⁶ t /% P ₂ O ₅ /		
	1982	c	d	f
<u>1. AFRICA</u>				
<u>North-West Africa</u>				
Algeria	294	1000/30% ^e /	525/32% ^e /	1200
Morocco	5680	40000/30% ^e /	42000	
Tunisia	1213	1300/30% ^e /	770	1500
<u>West Africa</u>				
Benin			30/28% ^e /	
Liberia		1,5/28% ^e /		
Mali		20/30% ^e /	5	
Mauritania		5/23-32% ^e /		
Niger			small	
Nigeria			not fully estimated	
Senegal	351	3200/30% ^e /	337/25-28% ^e /	
Togo	739	300/30% ^e /	130	
Upper Volta		4/27-31% ^e /	34/29% ^e /	
<u>Central Africa</u>				
Angola		120/30% ^e /	100/10-32% ^e /	
Centr.Afr.Rep.			6,6/25% ^e /	
Congo			unidentified	
Zaire		83/15% ^e /	83	
<u>East and Southern Africa</u>				
Burundi			150/3-22% ^e /	
Malawi			1,25/15% ^e /	
Tanzania		10/27-38% ^e /	10/20% ^e /	
Uganda		200	220/13% ^e /	
Zimbabwe	42	20/30% ^e /	37	

Appendix 4/3

Table 4 /cont'd/

C o u n t r y	Production	Total reserves		
	10 ³ t P ₂ O ₅ 1982	c	d	f
<u>2. LATIN AMERICA</u>				
<u>Central America</u>				
Mexico	125	1140/30% ^e /		
Nicaragua			found	
<u>Caribbean</u>	-	-	-	-
<u>South America</u>				
Argentina			low grade	
Brazil	946	1745/30% ^e /		1600
Chile		4/30% ^e /		
Colombia	4	600/30% ^e /		
Peru	9	6100/30% ^e /		1502
Venezuela		40/30% ^e /	20	
<u>3. NEAR EAST</u>				
<u>N.E. Africa</u>				
Egypt	197	2800/30% ^e /	1350	4700
<u>N.E. Asia</u>				
Iran		130/30% ^e /		
Iraq	80	660/30% ^e /		
Jordan	1273 ^b	1000/15-30% /		
Lebanon		small /17-31% /		
Saudi-Arabia		1000/30% ^e /		
Syria	592	800/30% ^e /		980
Turkey	8	300/30% ^e /		

C o u n t r y	Production	Total reserves		
	10 ³ t P ₂ O ₅	10 ⁶ t /% P ₂ O ₅ /		
	1982	c	d	f
<u>South Asia</u>				
India	175	140/17,5%/		55
Pakistan		12/20-37%/		
Sri Lanka	5	300/30%/		
<u>East and South-East Asia</u>				
China	3125	30000/15%/		
Korea DPR	160	88/12,5%/		
Mongolia		1000/20-22%/	400	
Thailand			findings	
Viet Nam	175	500/30% ^e /		

a - Phosphate Rock Statistics 1982, International Fertilizer Industry Association Limited, 28, rue Marbeuf, 75008 Paris.

b - World Phosphate Rock Statistics 1981.
Phosphorus and Potassium No. 120. July/August 1982.
/Data calculated from tel-quel weight, assuming 30% P₂O₅/

c - Fertilizer Manual
Development and Transfer of Technology Series No.12., UNIDO

d - Fertilizers in developing countries; potential for setting up minifertilizer plants.

Appendix 4/3

Table 4 /cont'd/

- e - Tonnage and grade stated in terms of equivalent quantity of marketable phosphate rock of 30% P_2O_5 grade or higher.
- f - World Survey of Phosphate Deposits, 1980, The British Sulphur Corporation Limited, Parnell House, 25 Wilton Road, London.

Production of potash and reserves in the
developing countries

C o u n t r y	Production ^a in 1981/82 1000 t K ₂ O
China	24,4 /FAO estimate/
Chile	26,6
Congo	/the mine were closed down in 1977 due to a flooding/

C o u n t r y	Reserves ^b 10 ⁶ t	Plans ^b
Algeria	limited	no
Congo	redevelop the operation at the closed mine; 30 /carnallite/	no
Ethiopia	60 /K ₂ O/	start 1983-89
Libya	0,65 /K ₂ O/	no
Morocco	200 /carnallite/ 40 /sylvinite/	
Tunisia	24 /K ₂ O/	projected capacity by 1986 140 000 tpa KCl current capacity about 20 000 tpa K ₂ O; projected capacity- -expansion: in the first phases: 200 000 tpa in the second phase: 1,0.10 ⁶ tpa /late in the 1980s/
China	200 /KCl/	studies
India	n.a.	n.a.
Iran	60 /K ₂ O/	

C o u n t r y	Reserves ^b 10 ⁶ t	Plans ^b
Jordan	2000 /K ₂ O/	initial capacity: 240 000 tpa KCl total capacity /by 1985/: 1,2.10 ⁶ tpa
Pakistan	large	no
Thailand	large	projected capacity by 1990: 7.10 ⁶ tpa KCl
Brazil	525 /sylvinite/ 6350 /carnallite/	projected capacity by 1984: 500 000 tpa KCl; doubled by 1990
Chile	n.a.	current capacity about 24 000 tpa K ₂ O
Mexico	n.a.	projected capacity by 1984: 80 000 tpa KCl; doubled by 1990
Peru	n.a.	projected initial capacity by 1990: 100 000 - 200 000 tpa KCl

a - FAO Statistics

b - "The situation of the potash industry in the developing countries" by Fernand C. Angulo, UNIDO; presented at Lahore, Pakistan 1982

n.a. - not available

Production of Sulphur in-all-forms and
reserves in the developing countries
in 1981

1000 t S/S equivalent

C o u n t r y	Brimstone		Pyrites	Other forms	Total	Reserves b,c
	total	from wich sulphur recovered				
<u>1. AFRICA</u>						
<u>North-West Africa</u>						
Algeria ^a	15	15	-	-	15	0
Morocco ^a	-	-	38	-	38	0
<u>Central Africa</u>						
Angola	-	-	-	-	-	+
Zaire ^a	-	-	-	30	30	
<u>East and Southern Africa</u>						
Ethiopia	-	-	-	-	-	+
Kenya	-	-	-	-	-	0
Madagascar	-	-	-	-	-	0
Malawi	-	-	-	-	-	0
Tanzania	-	-	-	-	-	0
Zambia ^d	-	-	-	80	-	0
Zimbabwe ^a	-	-	25	5	30	
<u>2. LATIN AMERICA</u>						
<u>Central America</u>						
Costa Rica	-	-	-	-	-	+
Guatemala	-	-	-	-	-	+
Mexico ^d	1971	-	-	105	1896	+0

Appendix 4/3

Table 6 /cont'd/

C o u n t r y	Brimstone		Pyrites	Other forms	Total	Reserves b,c
	total	from wich sulphur recovered				
<u>Caribbean</u>						
Bahamas ^a	5	5	-	-	-	
Cuba ^a	8	8	2	-	10	
<u>South America</u>						
Argentina ^e	5,8	5,8	-	-	5,8	+0
Bolivia ^a	11,0	-	-	-	11,0	+0
Brazil ^a	150,0	150,0	-	-	150,0	0
Chile ^d	75	...	-	32	107,0	+
Colombia ^e	16,8	16,8	-	-	16,8	+0
Ecuador ^a	14,0	10	-	-	14,0	+
Peru	20	20	-	-	20	+0
Trinidad and Tobago ^e	12,8	12,8	-	-	12,8	
Uruguay ^a	2,0	2,0	-	-	2,0	
Venezuela	90,0 ^d	68,3 ^e	-	-	90,0 ^d	+0
<u>3. NEAR EAST</u>						
<u>N.E. Africa</u>						
Egypt ^a	20,0	20,0	-	-	20,0	+
Libya ^a	16,0	16,0	-	-	16,0	
<u>N.E. Asia</u>						
Afghanistan ^d	-	-	-	-	-	+
Bahrain ^a	36	36	-	-	36	
Cyprus ^a	-	-	20	-	20	0
Iran ^a	150	100	-	-	150	+
Iraq ^d	200	...	-	-	200	+

Appendix 4/3

Table 6 /cont'd/

C o u n t r y	Brimstone		Pyrites	Other forms	Total	Reserves b,c
	total	from wich sulphur recovered				
Jordan ^a	-	-	-	-	-	+
Kuwait	118 ^d	116,8 ^e	-	-	118 ^d	
Saudi-Arabia ^e	671,6	671,6	-	-	671,6	0
Syria ^a	8,0	8,0	-	-	8,0	
Turkey ^a	30,0	...	24,0	65,0	119,0	+0

4. FAR EAST

South Asia

India ^d	5	...	20	80	105	+0
Nepal	-	-	-	-	-	0
Pakistan ^a	small	-	-	15	15	+

East and South-
-East Asia

Burma	-	-	-	-	-	0
China ^d	200	-	2100	75	2375	
Indonesia ^a	small	-	-	-	-	+0
Korea DPR ^a	-	-	255	10	265	
Korea Rep.	36 ^a	9,9 ^e	small ^a	54 ^a	90 ^a	0
Philippines ^d	-	-	37	-	37	+0
Singapore ^a	25	25	-	-	25	
Thailand	-	-	-	-	-	+0

a - Bureau of mines minerals yearbook, 1981. US Department of the Interior

b - Mineralnue reszurszu promüslennu razvitüh kapitaliszticeszkih i rajzvivajuscshszja sztran 1978. Moszkva, 1979. Szojuzgeolfond, 444 p.

- c - Opportunities for the establishment of mini fertilizer plants in the developing countries. Sectorial Studies Branch, UNIDO 1983.
- d - Preliminary Sulphur and Sulphuric Acid Statistics 1982, May 1983, pp. 1-2.
The British Sulphur Corporation Limited, London.
- e - Oil and Gas Journal, 8 August 1983, pp. 114-118.

Brimstone: includes Frasch, native and byproducts based on petroleum and natural gas.

Other forms: When data of sulphur recovered are available it includes byproducts based on coal and metallurgy;
When data of sulphur recovered are not available it includes byproducts based on coal, metallurgy, petroleum and natural gas.

Reserves:
+ - Sulphur
O - Pyrite

Raw materials potential for fertilizer production
in developing countries studied
/1983/

C o u n t r y	Natural gas	Crude oil	Coal, lignite hydropotential	Phosphate rock	Potash
<u>1. AFRICA</u>					
<u>North-West Africa</u>					
Algeria	+	+	-	+	-
Morocco	+	+	+	+	+
Tunisia	+	+	-	+	+
<u>West Africa</u>					
Benin	-	-	+	+	-
Gambia	-	+/?/	-	-	-
Ghana	-	+	-	-	-
Guinea	-	/?/	-	-	-
Ivory Coast	-	+	-	-	-
Mali	-	+/?/	+	+/?/	-
Mauritania	-	+/?/	-	-	-
Niger	-	-	-	+	-
Nigeria	+	+	+	+	-
Senegal	-	+	-	+	-
Sierra Leone	-	/?/	+	-	-
Togo	-	-	-	+	-
<u>Central Africa</u>					
Angola	+	+	+	+	-
Cameroon	+	+	+	-	-
Centr. Afr. Rep.	-	-	-	+	-

C o u n t r y	Natural gas	Crude oil	Coal, lignite hydropotential	Phosphate rock	Potash
Chad	-	+/?/	-	-	-
Congo	+	+	-	+	+
Gabon	+	+	-	-	-
Zaire	+	+	+	+	-
<u>East and Southern Africa</u>					
Botswana	-	-	+	-	-
Burundi	-	-	-	+	-
Ethiopia	-	+/?/	+	-	+
Kenya	-	/?/	-	-	+
Madagascar	-	+/?/	+	-	-
Malawi	-	-	+	+	-
Mozambique	-	/?/	+	-	-
Somalia	-	/?/	-	-	-
Tanzania	+	/?/	+	+	-
Uganda	-	-	-	+	-
Zambia	-	/?/	+	+	-
Zimbabwe	-	/?/	+	+	-
<u>2. LATIN AMERICA</u>					
<u>Central America</u>					
Costa Rica	-	/?/	-	-	-
El Salvador	-	/?/	-	-	-
Guatemala	-	+	-	-	-
Honduras	-	/?/	+	-	-
Mexico	+	+	+	+	+
Nicaragua	-	/?/	-	-	-
Panama	-	+/?/	-	+/?/	-

Appendix 4/3

Table 7 /cont'd/

C o u n t r y	Natural gas	Crude oil	Coal, lignite hydropotential	Phosphate rock	Potash
<u>Caribbean</u>					
Cuba	-	+/?/	-	-	-
Dominican Rep.	-	/?/	-	-	-
Haiti	-	-	+	-	-
Jamaica	-	/?/	-	-	-
<u>South America</u>					
Argentina	+	+	+	+/?/	-
Bolivia	+	+	-	+/?/	-
Brazil	+	+	+	+	+
Chile	+	+	+	-	+
Colombia	+	+	+	+	-
Ecuador	+	+	+	-	-
Paraguay	-	/?/	-	-	+
Peru	+	+	+	+	+
Trinidad and Tobago	+	+	-	-	-
Uruguay	-	/?/	-	-	-
Venezuela	+	+	+	+	-
<u>3. NEAR EAST</u>					
<u>N.E. Africa</u>					
Egypt	+	+	-	+	-
Libya	+	+	-	-	-
Sudan	+	+	-	-	-
<u>N.E. Asia</u>					
Afghanistan	+	-	-	+	-
Iran	+	+	-	-	+
Iraq	+	+	-	+	+
Jordan	-	-	-	+	+
Lebanon	-	/?/	-	-	-

Appendix 4/3

Table 7 /cont'd/

C o u n t r y	Natural gas	Crude oil	Coal, lignite hydropotential	Phosphate rock	Potash
Saudi-Arabia	+	+	-	+/?/	-
Syria	+	+	-	+	-
Turkey	+	+	+	+/?/	-
Yemen PDR	+	+/?/	+	-	-
<u>4. FAR EAST</u>					
<u>South Asia</u>					
Bangladesh	+	/?/	+	-	-
India	+	+	+	+	-
Pakistan	+	+	+	-	+
Sri Lanka	-	-	-	+	-
<u>East and South-East Asia</u>					
Burma	+	+	+	-	-
China	+	+	+	+	+
Indonesia	+	+	+	+	-
Korea DPR	-	-	+	+	-
Korea Rep.	-	/?/	+	-	-
Malaysia	+	+	+	-	-
Philippines	+	+	+	-	-
Thailand	+	+	+	+	+
Viet Nam	-	-	+	+	-

Number of

countries: 81

39

18

40

41

16

+ : available

- : not available

+/?/ : may be available

/?/: no oil reserves identified,
refining capacity may be
available

Appendix 4/4 - Potential users of mini fertilizer plants

Table 1

Potential users of mini N fertilizer plants
/demand versus mini-plants capacities in countries identified
as potential users of mini fertilizer plants/

as potential users of mini fertilizer plants/							1000 tpy N
/demand versus mini-plants capacity							
1990				2000			
	Capacity of mini-plants	Demand	Balance	Total capacity of mini-plants	Demand	Balance	
1. Africa	524	499,8	+ 24,2	1264	910,1	+ 353,9	
North-West Africa	-						
West Africa	176	180,0	- 4,0	472	399,0	+ 73,0	
Ghana	-	15,0		40	34,0		
Ivory Coast	40	25,0		80	30,0		
Mali	-	9,0		40	15,0		
Nigeria	136	120,0		272	210,0		
Senegal	-	11,0		40	60,0		
Central Africa	160	47,2	+112,8	230	77,5	+ 202,5	
Angola	40	12,3		80	25,0		
Cameroon	40	28,0		80	39,0		
Congo	40	3,2		40	7,0		
Gabon	-	0,3		40	0,5		
Zaire	40	3,7		40	6,0		
East and Southern Africa	188	272,6	- 84,6	512	433,6	+ 73,4	
Burundi	40	0,9		40	2,3		
Ethiopia	40	35,0		80	64,0		
Madagascar	-	5,9		40	15,0		
Malawi	40	28,3		80	40,3		
Zambia	-	72,5		136	128,0		
Zimbabwe	63	130,0		136	184,0		

Table 1/cont'd/

		1990			2000		
		Capacity of mini-plants ^a	Demand	Balance	Total capacity ^a of mini-plants	Demand	Balance
2. Latin America		1004	3781,0	-2777,0	2348	6478,0	-4130,0
Central America		244	1449,5	-1205,5	488	2040,0	-1552,0
Guatemala		68	62,5		136	105,0	
Mexico		136	1366,0		272	1890,0	
Panama		40	21,0		80	45,0	
Caribbean		204	449,0	- 245,0	408	666,0	- 258,0
Cuba		136	392,0		272	581,0	
Dominican Rep.		68	57,0		136	85,0	
South America		556	1882,5	-1326,5	1452	3772,0	-2320,0
Argentina		80	75,0		160	120,0	
Brazil		204	1300,0		544	2844,0	
Chile		68	99,0		204	162,0	
Colombia		68	195,0		272	300,0	
Ecuador		136	66,5		272	120,0	
Peru		68	147,0		204	226,0	
3. Near East		420	1950,0	-1530,0	1152	2783,0	-1631,0
N.E.Africa		108	904,0	- 796,0	284	1300,0	-1016,0
Egypt		68	823,0		204	1120,0	
Sudan		40	81,0		80	180,0	
N.E. Asia		312	1046,0	- 734,0	868	1483,0	- 615,0
Afghanistan		40	36,0		120	83,0	
Turkey		272	1010,0		748	1400,0	

Appendix 4/4.

	1990			2000		
	Capacity of mini-plants ^a	Demand	Balance	Total capacity of mini-plants ^a	Demand	Balance
4. Far East	3160	25172,0	-22012,0	8176	40362,0	-32186,0
South Asia	856	7442,0	-6586,0	2392	15106,0	-12714,0
Bangladesh	136	420,0		340	910,0	
India	476	5660,0		1292	11750,0	
Nepal	40	22,0		80	46,0	
Pakistan	204	1340		680	2400,0	
East and South-East Asia	2304	17730,0	-15426,0	5784	25256,0	-19472,0
Burma	136	143,0		272	237,0	
China	1040	14231,0		2400	19923,0	
Indonesia	340	1370,0		884	2100,0	
Korea DPR	40	776,0		120	850,0	
Malaysia	136	230,0		476	346,0	
Philippines	340	350,0		816	600,0	
Thailand	136	250,0		340	480,0	
Viet Nam	136	380,0		476	720,0	

a - unit capacity: 40 000 tpy N for 150tpd NH₃
68 000 tpy N for 250tpd NH₃

Appendix 4/4

Table 2

Potential users of mini P₂O₅ fertilizer plants
/demand versus mini plants' capacities in countries identified as potential
users of mini fertilizer plants/
1000 tpy P₂O₅

Country	1990				2000	
	Capacity of mini-plants ^a	Demand	Balance	Total capacity of mini-plants ^a	Demand	Balance
1. Africa	203	262,6	-59,6	522	509,0	+13,0
North-West Africa	-	-	-	-	-	-
West Africa	58	99,4	-41,4	174	155,2	+18,8
Mali	29	5,3		29	10,2	
Niger	-	1,8		29	2,3	
Nigeria	29	90,0		87	140,0	
Upper Volta	-	2,3		29	2,7	
Central Africa	29	11,1	+17,9	87	17,8	+69,2
Angola	-	7,2		29	11,0	
Centr.Afr.Rep.	29	1,1		29	2,3	
Zaire	-	2,8		29	4,5	
East and Southern Africa	116	152,1	-36,1	261	336,0	-75,0
Burundi	-	0,9		29	2,3	
Kenya	-	36,0		29	90,0	
Malawi	-	9,0		29	25,0	
Tanzania	29	18,0		29	39,0	
Uganda	29	1,2		29	3,7	
Zambia	29	30,0		29	61,0	
Zimbabwe	29	57,0		87	115,0	

Country	1990			2000		
	Capacity of mini-plants ^a	Demand	Balance	Total capacity of mini-plants ^a	Demand	Balance
2. Latin America	290	2087,0	-1797,0	696	3556,0	-2860,0
Central America	29	42,0	- 13,0	58	71,0	- 13,0
Guatemala	29	42,0		58	71,0	
Caribbean	29	118,0	- 89,0	87	190,0	- 103,0
Cuba	29	118,0		87	190,0	
South America	232	1927,0	-1695,0	551	3295,0	-2744,0
Argentina	29	66,0		87	107,0	
Brazil	58	1600,0		145	2740,0	
Chile	58	115,0		116	188,0	
Colombia	58	120,0		145	192,0	
Ecuador	29	26,0		58	68,0	
3. Near East	58	968,0	- 910,0	174	1537,0	-1363,0
N.E. Africa	29	195,0	- 166,0	87	320,0	- 233,0
Egypt	29	195,0		87	320,0	
N.E. Asia	29	773,0	- 744,0	87	1217,0	-1130,0
Turkey	29	773,0		87	1217,0	

Country	1990			2000		
	Capacity of mini-plants ^a	Demand	Balance	Total capacity of mini-plants ^a	Demand	Balance
4. Far East	609	7192,0	-6583,0	1653	12244,0	-10591,0
South Asia	145	2580,0	-2435,0	435	4830,0	- 4395,0
India	87	2180,0		261	4110,0	
Pakistan	58	400,0		174	720,0	
East and South-East Asia	464	4612,0	-4148,0	1218	7414,0	- 6196,0
China	290	3812,0		754	6100,0	
Indonesia	58	410,0		174	580,0	
Korea DPR	29	190,0		87	250,0	
Viet Nam	87	200,0		203	484,0	

a - unit capacity: 29 000 tpy P₂O₅

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☐☐

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☐☐

(3) Was the information provided new?

☐☐

(4) Did you agree with the conclusion?

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